1973 at the Northeastern Station

FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
NORTHEASTERN FOREST EXPERIMENT STATION
WARREN T. DOOLITTLE, DIRECTOR
1974

FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE, UPPER DARBY, PA.

1973 at the Northeastern Station

CONTENTS

1973: GENERAL 1
RESEARCH ACCOMPLISHMENTS 4
PUBLICATIONS 20

NORTHEASTERN FOREST EXPERIMENT STATION
WARREN T. DOOLITTLE, DIRECTOR • 1974

The new Forestry Sciences Laboratory at Durham, New Hampshire, was opened in 1973.

1973: GENERAL

THIS WAS THE YEAR of the 50th Anniversary of the Northeastern Forest Experiment Station. The occasion was marked by a banquet and special program on June 28, 1973 at Wentworth-by-the-Sea, New Hampshire. Five of the former directors of the old Allegheny and Northeastern Stations were present: Samual T. Dana, C. Edward Behre, Reginald D. Forbes, Hardy L. Shirley, and Verne L. Harper. John S. Boyce and Ralph W. Marquis are deceased, and Richard D. Lane is on assignment in New Delhi, India.

Elwood R. Maunder, executive director of the Forest History Society, served as master of ceremonies. All of the former directors present made brief comments, and John McGuire (also an alumnus of the Station) made closing remarks.

One alumnus attending the affair was Walter H. Meyer, retired professor from Yale University, who was the first person to report for duty at the Northeastern Station in 1923 at Amherst, Massachusetts. Others attending the anniversary affair included Station retirees, present employees, and cooperators and friends of the Station. A copy of the publication *A History of the Northeastern Forest Experiment Station, 1923-1973*, was presented to each person in attendance at the anniversary. This history was prepared jointly by the Forest History Society and the Northeastern Station. Copies are still available at the Station.

Also, during the year, two new laboratories were dedicated—the Forestry Sciences Laboratory at Durham, New Hampshire, on June 28, 1973, and the Sugar Maple Laboratory at Burlington, Vermont, on August 20, 1973.

The new George D. Aiken Sugar Maple Laboratory at Burlington, Vermont.

Personnel

Dr. Miro Czapowskyj was transferred from the strip mine area restoration project to the spruce-fir silviculture project at Orono, Maine, where he will conduct forest soils research.

Dr. Stephen Horsley was transferred from the amenities and municipal watershed unit at Pennington, N.J., to the silviculture of Allegheny hardwoods unit at Warren, Pa. Dr. Horsely is a plant physiologist and will conduct research related to the establishment and growth of natural and artificial Allegheny hardwood regeneration.

Dr. H. C. Smith completed advanced graduate training at Syracuse University and was transferred to the silviculture of Appalachian hardwoods unit at Parsons, W. Va. Dr. Smith replaces G. R. Trimble as project leader and will conduct silvicultural and forest soils research at Parsons.

Dr. Gordon Mott, a biomathematician and ecologist, was transferred from the insect impact unit at Hamden, Connecticut, to the silviculture of northern hardwoods unit at Durham, N.H. Dr. Mott will be conducting research on competition and succession in northern hardwoods.

Two new research units located at Beltsville, Maryland, were assigned to the Northeastern Station by timber management research in Washington. One is physiology of mycorrhizae of forest trees, a pioneering research unit headed by Dr. Edward Hacskaylo, an internationally known specialist on mycorrhizae. His research team consists of Mrs. Davaline Beslow and Ms. Caroline Booker, research botanists, and Mr. John Melhuish, plant biochemist. The second research unit, culture and morphogenesis of meristems of forest trees, is engaged in fundamental research in plant physiology, and is led by Dr. John Romberger, plant physiologist. His team consists of Dr. Robert Gregory, plant anatomist, and Mr. Chris Tabor, plant physiologist.

John Whalen was selected to fill our administrative services officer position. John came to us from the division of administrative services in the Washington office. He replaces Rollin Lawrence, who transferred to a similar position with HEW.

Jack E. Allen replaced Merle Grant as classification and pay specialist. Jack came to us from the Bridger National Forest in R-4. Merle transferred to the Santa Fe National Forest in R-3.

Harold Kisloff replaced Frank Ribiero as employee development specialist. Harold came to us from the Naval Industrial Supply Center in Philadelphia. Frank transferred to the division of personnel management in the Washington office.

Robert Erickson has been selected to fill the assistant director position for support services, replacing Bernard F. Duffy who retired in December. Bob comes from the Washington office division of administrative management.

Jay Homeyer transferred from the biometrics branch in Upper Darby to the gypsy moth program in Hamden, Connecticut.

J. Melvin Reed was selected for our newly established position as equal employment opportunity specialist. Mel came from the Northeastern Area S&PF.

Paul Keene was selected for the business management specialist position in the Hamden administrative section. He replaced Perry Johnson, who resigned.

Rita Rammrath, information specialist in Upper Darby, resigned to get married and was replaced by Jane Riddle, a recent graduate of Penn State.

Brian Payne took over the duties of project leader of the environmental forestry project in Amherst, Mass. Payne replaced Jack Thomas, who transferred to the Pacific Northwest Station.

The Station lost several key people to retirement during this year. These include Bernard F. Duffy, assistant director for support services; Kenneth Reinhart, research forester, division of watershed, engineering, recreation, and wildlife habitat; George R. (Dick) Trimble, project leader for culture of northern Appalachian hardwood project in Parsons, W. Va.; Paul S. Wysor, technician in marketing research in Princeton, W. Va.; Roland Ferguson, scientist, in the survey project; Harold Eno, technician, in insect research in Hamden, Conn.; Stella Townsend, clerk-steno in Columbus, Ohio; and Rose Lewis, secretary to Dan Schmitt (TMR) in Upper Darby, Pa.

Information Services

In 1973, information services was involved in a national program for developing new visual techniques for the dissemination of research information. The pilot project concerned Dr. Alex Shigo's decay and discoloration pioneer research unit and involved S&PF and the Washington VIS division. A four-color illustrative art brochure entitled "A Tree Hurts Too" was developed and issued. It was also advertised and sold by the Superintendent of Documents. This initial effort has been well received by arborists, nurserymen, and conservation educators. Plans are to develop three other publications in the series, as well as a slide/tape presentation and an exhibit.

Information services also packaged the Pinchot Institute story on wildlife in suburbia in a kit and distributed over 300 of them. Its publications on bark and on air pollution were mentioned in Changing Times magazine, resulting in requests for over 3,000 copies. The air pollution brochure was also reissued by the Washington office as a national Forest Service publication.

Research Publications

In 1973, Station scientists and their cooperators were credited with publication of 259 articles, papers, and reports. During the year, 232 new manuscripts were received by our Publications Branch for editing and publication. Our editorial staff broke the chronic backlog of unpublished manuscripts, and near year's end only five manuscripts remained in the work pile.

Besides in-house publication of 111 papers, notes, and brochures, Station authors had articles published by the following:

Annual Review of Phytopathology
Canadian Entomologist
Canadian Journal of Forest Research
Catholic Cemetery
Central States Forest Tree Improvement Conference Joint Proceedings
Coal Mining and Processing
Cornell School for Christmas Tree Growers Proceedings
Ecologia Plantarum
Ecology and Reclamation of Devastated Land
Environmental Entomology
Forest Farmer
Forest Industries
Forest Products Journal
Forest Science
Horticulture
Journal of Applied Meteorology
Journal of Economic Entomology
Journal of Environmental Education
Journal of Forestry
Maine Forest Department
Mitteilungen der Forstlichen Bundes-versuchsanstalt Wien
National Maple Syrup Digest
National Wildlife
Natural History
New Hampshire Forest Notes
Northeastern Forest Tree Improvement Conference Proceedings
Northern Logger
Pennsylvania Forests
Pennsylvania Game News
Pennsylvania State University School of Forest Resources
Physiological Plant Pathology
Phytopathology
Plant Disease Reporter
Research and Applied Technology Symposium on Mined-land Reclamation
Second International Congress of Plant Pathology
Southern Lumberman
Technometrics
Torrey Botanical Club Bulletin
Tree Planters' Notes
Trees
University of Kentucky Agricultural Experiment Station
USDA Forest Pest Leaflets
Virginia Forests
Water Resources Research
Wild Turkey Management

Our editorial staff pressed ahead with their writer-training program. Informal writer-training workshops were held at several Station field units. We also took part in writing seminars for faculty and graduate students at the State University of North Carolina and the University of New Hampshire.

Work was resumed on our EDITORS' NOTEBOOK FOR AUTHORS, and 49 new Notes in this writer-training series were issued. These Notes, based mainly on examples from Station authors' manuscripts, deal with various aspects of word usage, style, sentence structure, punctuation, syntax, etc. Though designed for in-Station training purposes, the Notes have attracted a growing list of users.

Administrative Management

Administrative management completed support services workload analysis and staffing studies in the Amherst, Berea, Delaware, Hamden, Princeton, and Warren field units. Data is now being collected and analyzed to complete these studies for the field units in Burlington, Columbus, Durham, Morgantown, Orono, and Parsons in 1974.

The branch has also completed studies of air operations, technical information retrieval systems for research and ADP, and teleprocessing services in Upper Darby. New ADP systems for 1973 were the automated mailing list and label system that produces pressure-sensitive addressing labels from the computer and the entire programming for the NA S&PF multiple accomplishment reporting system.

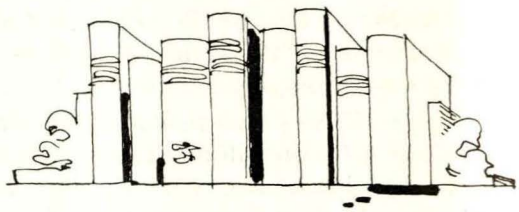
January 1974 will see the completion of the NA S&PF excess property reporting and control system for the fire management group.

Biometrics

Our staff has developed several computer programs to aid in data analysis. One program does "profile analysis". A set of programs that compute the expected mean squares for fixed, random, or mixed linear models has been completed.

Library

The Station headquarters library, which also serves the Northeastern Area State and Private Forestry, recently moved from 6808 Market Street to the fourth floor of 6816 Market Street. The new quarters are much more efficient and more convenient for staff and other users, including field personnel on visits to Upper Darby.



RESEARCH ACCOMPLISHMENTS

Symposiums and Conferences

To help solve some of the present multiple-use problems on municipal watersheds—problems of maintaining adequate water supplies while meeting demands for a variety of other uses—a regional Municipal Watershed Management Symposium was held in September 1973. This was a program of the Northeastern Station's Pinchot Institute, co-sponsored by the Pennsylvania State University and the University of New Hampshire. To provide an opportunity for a maximum number of watershed managers to attend, the symposium was presented twice: at the Pennsylvania State University on September 11 and 12, and again at the University of New Hampshire on September 19 and 20. Major topics presented and discussed were: effects of management practices on water quality and quantity, pros and cons of current management practices, multiple-use management possibilities, income opportunities, recreation demand implications, impact of construction activities, use of chemicals for timber and reservoir management, meeting future quality standards for drinking water, technical assistance programs, and the consultant's role in municipal watershed management. Proceedings will be published by the Station.

To help protect and maintain wildlife habitat and its associated values in densely populated areas, a symposium entitled "Wildlife in an Urbanizing Environment" was held in November 1973, sponsored by the Cooperative Extension Service of the University of Massachusetts in cooperation with the Northeastern Station's Pinchot Institute and several other leading wildlife agencies, organizations, and institutions. The symposium dealt with the philosophy of urban wildlife management, the role of the public and private wildlife organizations and the results of a wide range of studies of urban wildlife. Proceedings will be

published by the Cooperative Extension Service of the University of Massachusetts.

Because of the widespread interest in and concern for managing landscapes throughout Megalopolis, a conference on "Landscape Assessment: Values, Perceptions, and Resources" was held in November 1973, co-sponsored by the Pinchot Institute, the Institute for Man and His Environment at the University of Massachusetts, and several other agencies concerned with landscape management. The conference was organized in three sections: discussion of qualitative landscape values, assessment of human responses to the landscape, and assessment of landscape resources. Proceedings will be published by the Institute for Man and His Environment.

The Station cooperated with the forest pest management group of the Northeastern Area S&PF to present the 2nd Northeastern Radiography Workshop at Delaware, Ohio, April 3 to 6, 1973. The workshop covered the theory and application of x-rays in forestry. Participants came from most parts of the United States and from Canada, and represented the Forest Service and other federal and state organizations.

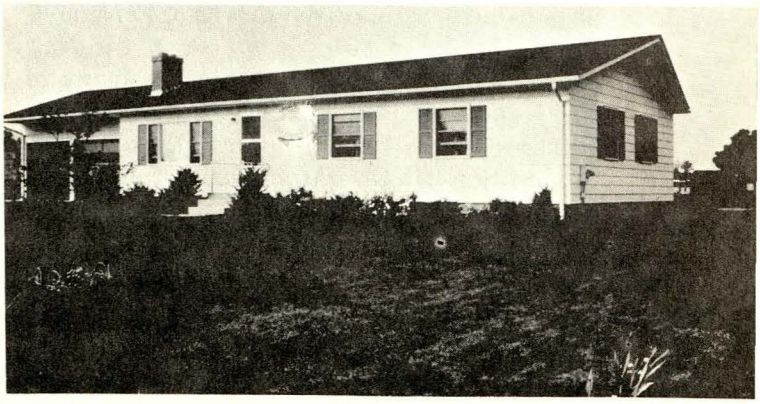
Backyard Wildlife

Anthropologist Rhoda Metraux has said that only when man has incorporated into the urban setting all that he once gained through living in nature will he be "fully and faithfully . . . urbanized." Our society has been alerted to the deterioration of our environment, and we have heard the call to great crusades, both public and private. Yet there is the question in many minds: what can one person do? You can improve your own environment where it means most to you—in your own backyard—by making it more inviting to wildlife. An important publication by Station scientists on this subject has prompted the National Wildlife Federation to launch a program to establish a nationwide network of mini-refuges in the backyards of Federation members (*Thomas et al. 1973*).

The Value of Trees to Your Home

The economic importance of trees near homes is often overlooked. When decisions affecting land use and values are made, there is a tendency to place much greater weight on measurable dollar costs than on so-called intangible factors, such as trees. Research has shown, however, that even though we cannot measure in economic terms many of the benefits from trees in metropolitan areas, the benefits we are able to measure are quite large. In one study, it was found that trees contributed 7 to 15 percent to suburban property values. That means, for example, that in a city of 10,000 homes with an average value of $30,000 each, the value of residential trees (at the 7 percent rate) would be $21 million (*Payne 1973*).

The property value of the house with trees is 7 percent more than a similar property without many trees (**Payne 1973**).



Metro Forest Case Study

Often unrecognized, more often mistreated, the forests within America's metropolises are sanctuaries from the glare, noise, and foul air of the city. A recent controversy involving an urban open space was described in order to show the general plight of the urban forest, the decisions involved in its survival, and the manner in which amenity and aesthetic values compete with technological requirements of urban man (*Gordon and Lambrix 1973*).

Use of Fire

Several articles in the October 1973 issue of the Journal of Forestry dealt with fire in wildland management. In "Comments from the Northeast" Little pointed out that many of the statements in Professor Crow's "Use of Fire in Southern Forests" were also applicable in the pitch-shortleaf pine section of New Jersey and the loblolly pine section of Maryland —sections where past Station research in cooperation with state foresters permitted the application of fire to start many years ago. In other sections of the Northeast there may be roles for fire, as an alternative to machinery or chemicals, in favoring certain stand compositions, in providing grassy openings, or in favoring certain wild flowers, game, or songbirds. Further research is needed to define the proper fire regimes for these beneficial effects (*Little 1973*).

Successional Concept

Successional stages from primary invaders to climax associations have long been a tenet in ecology, but in recent years certain ecologists have questioned the universal applicability of the concept—for example, in the New Jersey pine barrens. In the barrens many of the stands, shaped as they are by periodic wildfires and cutting, do *seem* to have a static composition. However, there have been appreciable changes in the composition of barrens forests since settlement, in part due to the succession from conifers to hardwoods. The succession on uplands is most easily seen in old-field pine stands, and there marked changes can occur within a short span of time: in 18 years the number of overstory pines can drop by about 50 percent and the number of hardwoods 1.4 cm and larger in diameter (dbh) can increase by up to 1,000 per 0.4 hectare (1 acre). Treatments such as thinning and prescribed burning do affect this change in composition (*Little 1973*).

National Publications

At the national level, the Forest Service published two major forestry publications, *The Outlook for Timber in the United States* (USDA Forest Service, Forest Resource Report No. 20) and, *Silvicultural Systems for the Major Forest Types of the United States*, (USDA Agriculture Handbook No. 445).

Northeastern Station researchers made important contributions to *Outlook for Timber* . . . Chapter III, "Opportunities for increasing timber supplies," is an essentially new and highly relevant addition to timber resource reports. Sam Gingrich, Dave Gansner, Dave Worley, and Joe Barnard, in particular, provided the research expertise necessary for the preparation of pages 112 to 116.

Northeastern Station silviculturists contributed to the entire section on Northeastern Forest types in *Silvicultural Systems* . . . (Spruce-fir: *Gibbs*; Eastern White Pine: *Little*, Beck, and Della-Bianca; Northeastern Northern Hardwoods: *Filip* and *Leak*; Cherry-Maple: *Marquis*; and Appalachian Mixed Hardwoods; *Trimble*), as well as Oak-Hickory: Watt, Brinkman, and *Roach*, in the North Central forest types.

Silvicultural Systems . . . provides the busy forester and interested layman with an up-to-date digest of the most recent silvicultural information and recommended treatments for each major type in the country. Each article was prepared by a leading Forest Service research authority on the silviculture of the type.

Spruce-Fir

Advanced regeneration is considered to be the key to successful treatment of spruce-fir stands, and little thought is given to the quality of the regeneration. A recently published

research study suggests that regeneration under a canopy occurs in waves corresponding to periods of canopy disturbance. The quality of advanced regeneration in spruce-fir stands appears to depend on establishment cycles and relative age (*Blum 1973*).

A simply written, comprehensive guide to silviculturally sound treatment of spruce-fir forests in New England has been lacking until now. A unique but extremely useful feature of a silvicultural guide for spruce-fir in the Northeast (*Frank and Bjorkbom 1973*) published by the Northeastern Station, is a key which enables the forester to find an optimal stand prescription for a given forest condition.

Northern Hardwoods

Northern hardwoods vary considerably in composition and stand structure. Consequently, several silvicultural systems have been proposed to treat northern hardwood stands in the Northeast. Filip (*1973*) provides an authoritative review of them, describes the situations appropriate for each, and summarizes the latest research bearing on the application of a chosen system.

Soils developed from granite support extensive stands of northern hardwoods in New England. Soil analyses of 17 typical soils in the White Mountains, N.H. have been published. In addition to listing soil properties by type, Hoyle (*1973*) presents information on humus and litter conditions, nitrogen relations, water relations, and recommendations for soil improvement.

Sugar Maple

Tree characters such as crown size, competition, and past growth have often been used by sugar bush managers to gauge sap sweetness and yield. Detailed analyses of 180 randomly selected sugar maple trees from three different sugar bushes disclosed that tree characters could not be reliably employed to predict either sweetness or sap yield, though some characters could be used as a rough guide to sap yield within a sugar bush (*Blum 1973*).

A sugar maple is capable of producing sap for a long time, but a tree cannot be tapped again at the same location until the hole has closed and is covered with a layer of wood equal to the taphole depth. Repeated tapping can also be expected to cause serious lumber degrade beyond the zone of tapping. Recent research provides information on the rate of taphole closure, extent of cambial dieback, and the potential for degrade (*Gibbs and Smith 1973*).

Appalachian Hardwoods

Hardwood regeneration analyses have been conducted in West Virginia for a complete range of silvicultural systems as applied to ex-

Release of very young hardwood crop trees—such as this 15-foot-tall, 7-year-old black cherry—is not recommended, because dominance relations are not well established at this early age and the crown position of most released trees is not permanently improved. **(Trimble 1973).**

cellent, good, and poor sites (oak indices 80, 70, and 60 respectively). The advanced regeneration component was also considered. The results of these analyses were reported to foresters and land managers at the hardwood symposium at Asheville, N.C. (*Trimble 1973*).

Even-aged management of eastern hardwood forests employing small clearcuts results in dense stands of reproduction. Ideally the identification and release of desirable crop trees will improve quality and accelerate growth of the regenerated stand. In Appalachian hardwoods it has been shown that crop tree identification and release at age 7 or before is relatively ineffective because dominance relations between trees are not well established at that early age (*Trimble 1973*).

Growth of black cherry seedlings has been increased to as much as 8 feet the first season after nitrogen and phosphorous fertilization, in contrast to growth of 1 to 2 feet on unfertilized controls. **(Auchmoody 1973).**

Intensive Culture

Three research papers report that substantial increases in hardwood growth can be achieved by the judicious application of fertilizers to juvenile material. Paper birch seedlings respond directly to nitrogen application, but show little response to phosphorous and potassium (*Bjorkbom 1973*). In combination, nitrogen and phosphorous accelerated growth. The response was greater than that achieved by nitrogen alone (*Bjorkbom 1973*). The author reports that foliar content of nitrogen is a reliable guide to the needs of paper birch seedlings for nitrogen.

In West Virginia, researchers discovered that calcium cyanide was uniquely effective in promoting the growth of yellow poplar (*Auchmoody and Wendel 1973*). This compound provides a readily available source of nitrogen and it is also toxic to seeds and herbaceous plants for 2 to 3 weeks after application. Application rates and their effects, and conclusions from a 3-year study are reported. Readers are cautioned that the report is a research study and calcium cyanide is not registered for the use described.

Forest Genetics

Forest geneticists frequently find that selected seed sources provide convenient and quickly realized genetic gains that can be exploited long before improved breeding populations can provide superior seed in quantity. A complete analysis of a range-wide white pine provenance study disclosed that white pines from certain seed sources were superior in height growth to those from other seed sources for relatively broad regions within the range of white pine. The author was able to define seed zones and make appropriate recommendations (*Garrett 1973*). However, no white pine seed source effectively resisted white pine weevil attack (*Garrett 1973*).

Many tree species have particular aesthetic value in selected situations. But tree species vary considerably in their ability to withstand environmental insults associated with amenity use and much of this variation is genetically controlled. A Northeastern Station geneticist has summarized the available information on

the prospects for selecting and breeding trees resistant to one such environmental insult—roadway deicing salt (*DeMerritt 1973*).

Tree improvement programs are intuitively appealing. But investment analysts are more interested in dollar returns than biological responses. An analysis of projected genetic gains from eastern hardwood tree improvement programs in relation to the associated costs disclosed that an attractive financial return could be realized for species with rapid growth, high reproductive potential, and high market values (*Marquis 1973*). Although financial analyses are available for pine and cottonwood tree improvement programs, the Northeastern report is the only thorough one available for northeastern hardwoods.

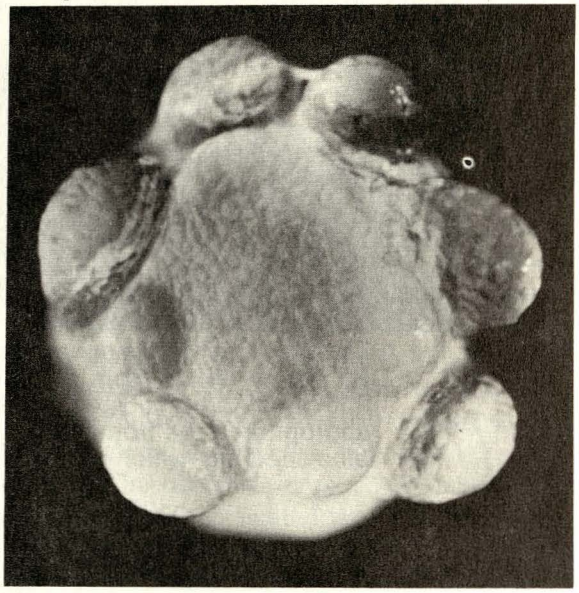
Mensuration

The Northeastern Station has for several years been conducting a series of studies on the growth patterns of important hardwood species as related to produce value. The results of these interdisciplinary research investigations have been published as "Rate of Value Increase . . ." Station papers. These papers have been in continuous demand by foresters and private landowners. The latest in the series is for sugar maple (*Mendel, Grisez, and Trimble 1973*).

Plant Physiology

Wavy and curly grain are highly prized and extremely valuable wood characteristics. Although wavy and curly grain patterns are infrequent in any species, they are not chance events. Waviness develops gradually, but once established persists through all subsequently formed wood. Painstaking "mapping" of a 3-micron tangential sections of xylem from maple, ash, and birch logs, with and without wavy grain, resulted in the identification of fields or locales in the cambium of wavy-grain specimens where cell division frequently occurs in a pseudotransverse plane rather than in the tangential plane. This produces new cells with orientations slightly different from normal, and establishes the wavy grain pattern which persists thereafter (*Hejnowicz and Romberger 1973*).

This shoot apex of **Picea abies** growing in culture shows the leaf primordia that have formed during the 10 days since the apex was excised. The technique is used to study the effects of biochemical and physical environment on leaf initiation. **(Romberger and Tabor 1973).**

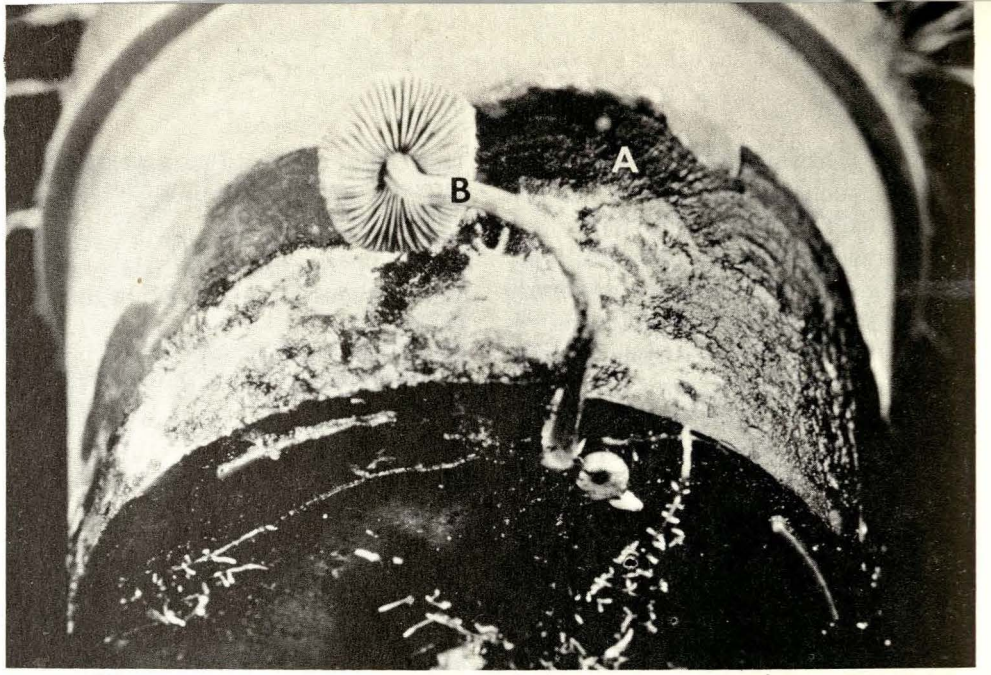


Ectomychorrhizae

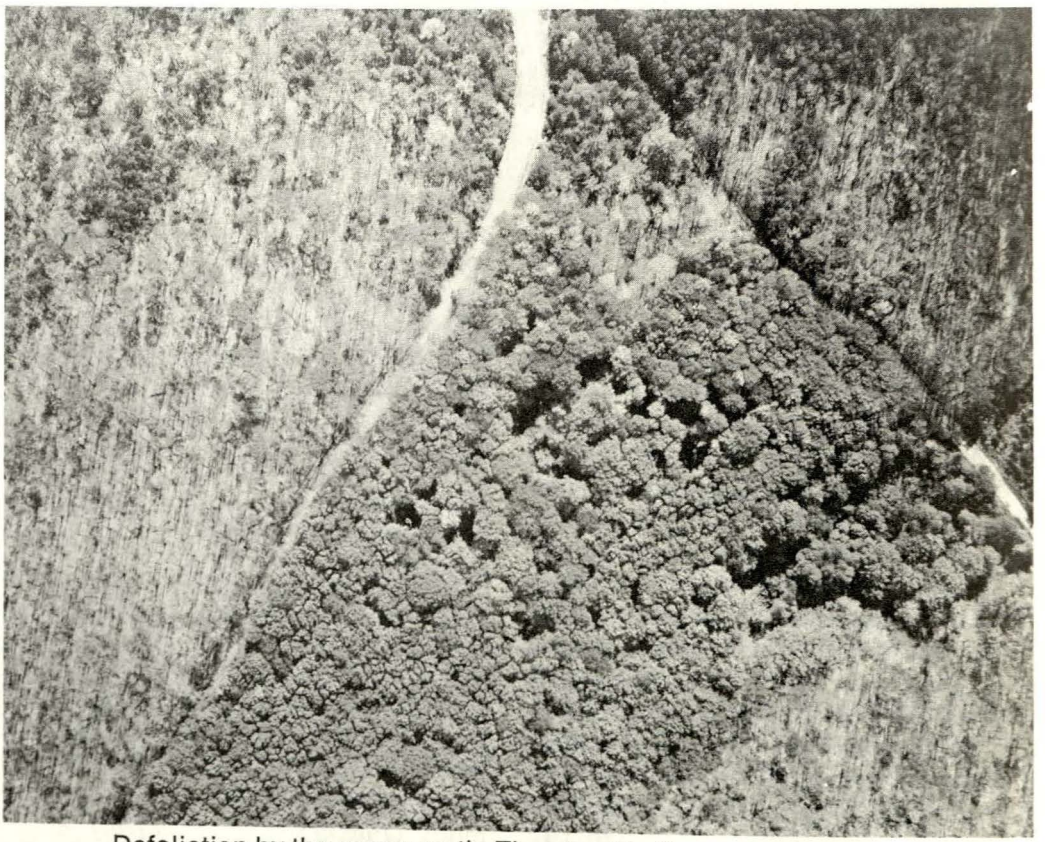
Academic Press has published a comprehensive summary of what is known about ectomycorrhizae. In Chapter 6, Dr. Hacskaylo (*1973*) describes the carbohydrate metabolism of host and fungus and their interrelationship. In general the fungus is dependent upon the host for its carbon sources, but is independently capable of metabolizing carbohydrates.

Gypsy Moth Research and Development

The gypsy moth research and development program is progressing toward the development of a management system for this major pest of our eastern hardwoods. Considerable progress has been made in the development of: (1) biological control agents and techniques for their application; (2) a means of assessing and predicting population trends of the gypsy moth (*Porthetria* (*Lymantria*) *dispar*); (3) an understanding of the relationship of the degree of defoliation to the productivity and sta-



The two fungi whose sporophores are visible here (marked **A** and **B**) derive all of their carbohydrates from the photosynthetic activity of the pine seedling that is growing inside the pot. The sporophores are from a mycorrhizal complex on the root of the pine seedling, which protrudes from the pot. **(Hacskaylo 1973).**



Defoliation by the gypsy moth. The stand in the center is a sugar bush that was sprayed with DDT for protection against the saddled prominent.

bility of deciduous forest stands, tree vigor, and predisposition of the tree to disease and secondary insect attack; (4) methods for increasing the effectiveness of predators (specifically *Peromyscus* sp.) in helping to maintain sparse gypsy moth populations at low levels; (5) new insecticides (systemics) for use against the gypsy moth; and (6) means of characterizing stands which have served or will serve as foci for gypsy moth infestations and stands which have suffered or will suffer from these infestations.

This year, on the basis of several years of laboratory and field tests by the Hamden staff and state and federal cooperators, *Bacillus thuringiensis* (Bt), was approved by EPA for aerial application as a foliage protectant. Newer and more efficacious formulations will be undergoing field testing.

Laboratory studies designed to provide the necessary safety and efficacy data for EPA registration of the gypsy moth virus are continuing. In addition, cooperative efforts with Forest Pest Management (FPM) are underway to obtain an adequate supply of the gypsy moth virus for field experiments and pilot tests in 1974 and 1975. At present, gypsy moth virus can be produced only by infecting live gypsy moth larvae. However, research is underway to determine whether this gypsy moth virus can be produced in tissue cultures of other lepidopterous insects.

The introduction of viruses into insect populations via conventional systems may be an inefficient use of materials such as these. Therefore, new introduction techniques are being investigated. Preliminary studies using gypsy moth parasites as the inoculating agent have shown considerable promise. These studies, as well as those involving the artificial contamination of gypsy moth egg masses with the virus, will be emphasized during the 1974 season.

The collection of field data on gypsy moth population levels and tree condition from the extensive plot system continued through the cooperative effort of FPM and several Northeastern States. These data are being used to test and improve the predictive capabilities of the gypsy moth forest simulator (*Campbell and Valentine 1972*).

Field studies were initiated in 1973 toward the development of a two-stage forest simulator to evaluate the impact of gypsy moth defoliation on the productivity and stability of deciduous forest stands where the gypsy moth has long been a pest. This simulator will also assist us in forecasting the impact of gypsy moth defoliation in regions not yet infested.

Effects of Defoliation

One aspect of our research deals with the physiological responses of trees to gypsy moth defoliation. Thus far, we have concentrated on determining the biochemical changes that defoliation elicits in food reserves, i.e., starch, sugars, and amino acids. Each of these entities changes markedly after severe defoliation, and they change in ways that appear to predispose the tree to attack by mortality-causing agents such as *Armillaria mellea*, the root-attacking fungus. The decrease in root starch after defoliation can be correlated with the degree and frequency of defoliation. Thus, root-starch content appears to be useful as a predictor of tolerance or susceptibility of trees and stands to additional defoliation. A paper describing a rapid and easy visual-staining method of assessing root starch content is being prepared, but the utility of the approach as a predictive tool must await the test of time. So far, those trees that have died, and those that have exhibited dieback symptoms, have been those with the lowest root starch content.

Recent studies have been designed to investigate other responses of the tree to defoliation. We have begun studies of how bark phenolic compounds are affected and also what changes occur in tree-produced enzymes. Phenolic compounds are involved in deterring attack by some fungi and insects, and certain enzymes may be responsible for retarding or containing the attack of *Armillaria mellea*. We have shown that these enzymes are produced in sufficient abundance in nonstressed trees to destroy the cell walls of *A. mellea*. We are now determining whether defoliation results in reduced production of these enzymes.

Stand Studies

We continued our attempts to characterize forest stands with respect to their susceptibility to damage by gypsy moth defoliation and the likelihood of their serving as foci for gypsy moth infestations.

Over the past two summers, 118 stands from Vermont to West Virginia have been sampled. These stands were selected to represent a variety of site conditions (ridges, slopes, sand flats, etc.), and a variety of defoliation histories. Included were stands that have proven historically to be "hotspots" or foci of infestations, and stands where mortality following defoliation has been severe. A number of stands were sampled in areas where the gypsy moth is a newcomer or where it has not yet arrived in force.

To date we have concentrated on comparing stands with respect to their composition and structure. Although it is too early to draw firm conclusions, it does appear that we will be able to characterize potential outbreak foci and also sites where damage will be great.

At the completion of this year's field season, the gypsy moth R&D program will undergo a critical evaluation to determine whether the current research efforts are adequate, whether they are responsive to the program's objectives, and whether the individual studies can be completed within the time-frame of the program.

New Data-Gathering Systems Aid in Insect Research

New methods of gathering data have been developed by the Hamden staff that will greatly facilitate insect research and development. Some of these new systems also have operational uses.

A microvideo system for counting very small objects was developed to aid in the counting of elm spanworm eggs. This system can also have practical applications in gypsy moth research (*Talerico and Skratt 1973*).

Small mammals have been recognized as important predators of the gypsy moth. However, little is known of their biology and natural mortality. A radio telemetry system has been designed to detect the death of small mammals and facilitate recovering remains (*Neely and Campbell 1973*).

A spray tower system has been developed to produce uniform droplet spectra with deposits similar to those produced by aerial application of insecticides. This system has been very useful in bridging the gap between laboratory assay of a candidate microbial insecticide and the actual field testing (*Hubbard and Lewis 1973*).

The evaluation and scheduling of white-pine weevil control programs is based on a system that was developed by the Station in cooperation with NA-S&PF (FPM). To use the evaluation scheme, an estimate of weevil intensity is needed. To meet this need, FPM provided field data for the development of a sampling method for estimating the proportion of never-weeviled trees in plantations (*Talerico and Wilson 1973*).

Managing Gypsy Moth Populations

Much of the current uncertainty in forest pest management revolves around the unresolved question of whether a given pest population should be suppressed or left alone. For the gypsy moth, this question could be resolved on rational grounds if we could answer the following questions:

1. What factors influence numerical changes in moth populations?
2. How can we accurately forecast how these populations will behave numerically in the future?
3. What effects will an uncontrolled gypsy moth population have on trees as well as on people?
4. What effect on the environment will be brought about by the use of any treatment, or combination of treatments?

Resource managers need accurate forecasts of how gypsy moth populations will behave numerically before they can make rational control decisions. They also need to know what effects their action (or inaction) may have upon the gypsy moth population, and how the public will react to their decision.

Numerical changes in gypsy moth populations in the Northeast have long been recog-

nized as unpredictable from one generation to the next. The apparently independent fluctuations from one year to the next often present resource managers with an exceptionally difficult situation.

Recent analysis of historical data from a sample of gypsy moth populations between 1911 and 1931 revealed that the numerical behavior of the overall system from one year to the next followed rather definite patterns. If these patterns are recognizable and predictable, they should provide the resource manager with a better basis for deciding on a rational management strategy for each situation, and for implementing that strategy. They may also provide those interested in the population dynamics of this insect with a better basis for further studies.

The accelerated 5-year gypsy moth R&D program was designed to achieve a better understanding of gypsy moth population dynamics, and to provide the technology for the integration of this knowledge into a pest management system. Progress toward this objective has been achieved (*Campbell 1973, Campbell 1973, Campbell 1973, McManus 1973*).

Attracting Elm Bark Beetles to Reduce Dutch Elm Disease Losses

Adults of the smaller European elm bark beetle, the primary vector of Dutch elm disease, are attracted initially to the declining elms in which they breed by host-produced odors. Virgin female beetles, as they tunnel into the tree, also produce powerful attractive chemicals called pheromones which are responsible for the mass attack of males and females on suitable breeding material. Forest Service entomologists are cooperating with scientists in the Department of Forest Entomology and Forest Chemistry of the New York State University College of Forestry at Syracuse University in attempts to isolate, identify, and artificially synthesize female-produced pheromones and host attractants.

The ultimate goal of this research is to use the attractants to reduce elm bark beetle populations and thus bring about a corresponding decrease in the incidence of Dutch elm disease. One approach is to use the synthetic attractants to lure large numbers of beetles away from healthy elms and to traps where they would be killed. A significant reduction in the incidence of Dutch elm disease might result if enough beetles were killed through trapping. The attractants might also be used as a confusant to reduce mating; they could be dispersed to confuse males seeking a mate and thus thwart mating. If the attractants prove successful in either case, their use will have one major advantage over existing methods—it will be a safe, nonpolluting control measure that should have no effect on organisms other than elm bark beetles.

During the past year significant progress has been made toward isolating and identifying the attractants. Entomologists have succeeded in developing techniques for mass producing the crude attractant produced when female beetles tunnel in elm logs. This crude attractant has been fractionated and purified by the chemists, and the active constituents have been tentatively identified. It now appears that the attractant "bouquet" is composed of at least three different chemicals, which act in combination to attract beetles to females tunneling in suitable elm tissue. Field tests indicate that these three chemicals will attract large numbers of beetles of both sexes when presented in a suitable delivery and trapping system. Studies are now in progress to evaluate the effectiveness of various combinations of the attractive chemicals in competition with natural material, the optimum relative concentrations of the components, and the suitability of various delivery and trapping systems.

Only through intensive and continued trapping will we be able to determine the effectiveness of an attracting and trapping program in reducing Dutch elm disease. Successful tests with the attractants may lead to their use, in conjunction with sanitation, as a replacement for insecticides for the control of beetles, especially in areas of low Dutch elm disease incidence.

Association of Mycoplasmalike Organism with Walnut and Pecan Bunch Diseases

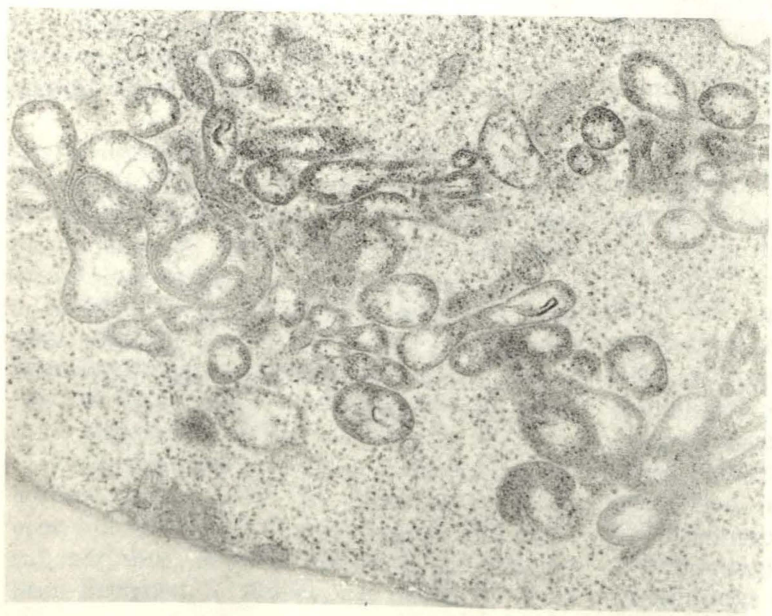
Serious losses have been recorded from a disease called walnut bunch. It is a yellows-type witches'-broom disease that occurs on Japanese, English, and native black walnut, and on butternut. It was formerly presumed to be caused by a virus. An extensive electron microscope investigation of the phloem tissues of infected walnut revealed a mycoplasmalike organism (MLO) in diseased but not in healthy leaf, stem, and root phloem cells. The abundance of MLO was greater in severely broomed branches than in branches with mild brooms. MLO were not observed in nonsymptomatic branches of diseased trees. Virus particles were not observed. Their absence, together with the consistent presence of MLO in diseased but not in healthy walnuts, suggests that MLO may be the causal agent.

Pecan bunch, also thought at one time to be virus-induced, is a widespread and serious disorder that occurs throughout the commercial range of southern pecan, *Carya illinoensis*. In this disease also, an MLO consistently associated with diseased but not with healthy trees strongly points to MLO etiology. Unlike some other mycoplasma diseases, pecan bunch is not systemic throughout the tree: the MLO are found in phloem sieve elements and companion cells of stems and leaves of affected trees. They are most abundant in severely broomed branches and are rarely observed in nonsymptomatic tissues. Antibiotics have been successfully used to treat some mycoplasma disorders. Studies are underway to determine if such treatments can be used effectively to control mycoplasma diseases in trees.

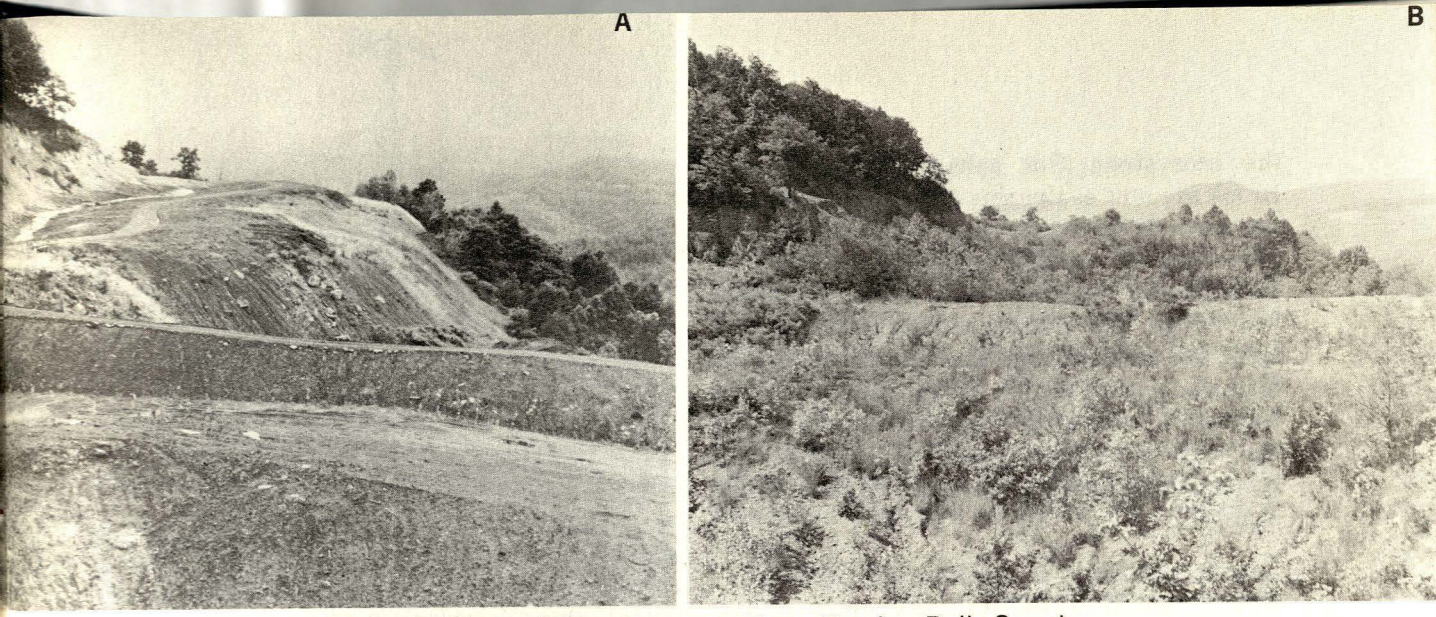
Shrubs and Vines for Wildlife

Station wildlife biologists at Morgantown finished compiling a handbook on managing 100 species of shrubs and woody vines that are important for wildlife in the Northeast. This work is in cooperation with the Northeastern Deer Study Group, the Association of Northeast Game, Fish, and Conservation Commissioners, and many others. The handbook of about 200 pages will be published early in 1974 as General Technical Report NE-9[1] and will fill a need that has been felt for many years. Information about some of the wildlife values of timber tree species has been generally available, but not information about the

[1] Gill, John D., and William M. Healy. 1974. Shrubs and vines for Northeastern Wildlife. USDA Forest Serv. Gen. Tech. Rep. NE-9, 180 p.



Mycoplasmalike organisms in phloem tissue of walnut with bunch disease. The MLO are pleomorphic and vary in length from 150 to 1000 nm. They are enclosed in a plastic trilaminar unit membrane. Spherical or oval shapes predominate but tubular forms were evident near sieve plates. Binary fission is suggested by the appearance of forms with centralized constrictions. Some sections clearly show the presence of ribosome- and DNA-like material within the MLO cells.



Strip mine reclamation demonstration, Fonde, Bell County, Kentucky. **A:** Before reclamation treatment, spring 1965. **B:** After reclamation treatment, September 1971.

shrubs and vines that are so important to wildlife. Until recently most wildlife habitat research has been focused almost exclusively on game species; in this handbook the authors made a special effort to present information that also pertains to nongame species. Publication of the handbook is especially welcome now because of the increased effort of managers to attain full multiple use of forest lands, including wildlife and landscape values.

Mined-Area Reclamation

With ever-increasing concern and controversy over strip mining and strip-mine regulation, our continuing research on reclamation of mined areas has taken on added importance. The Forest Service has been conducting reclamation research since the thirties. Early work was generally limited to revegetation studies. More recent work has covered, besides revegetation (see for example *Vogel and Berg 1973*, *Plass 1973*, *Davis 1973*, and *Czapowskyj 1973*), many aspects of streamwater quality (*Curtis 1973*), spoil characteristics (*Czapowskyj and Sowa 1973*, *Berg and Vogel 1973*, and Curtis, *1973*), and engineering (Williams *1973*). Our scientists are working closely with the state regulatory agencies in developing reclamation criteria, in training personnel, and in evaluating the adequacy of specific regulations. Besides their proven value in advancing practical reclamation in the Appalachian states, the results of our work are providing a firm foundation for a comprehensive new research program (SEAM) aimed at developing adequate reclamation measures for the extensive surface mining for coal that is expected to occur in the West. Grant Davis, who has been in charge of our reclamation work since 1959, has been selected to direct the research for this western program. Though much has been accomplished, a big job remains to be done in both East and West if we are to protect the important environmental values as coal is extracted to meet our energy needs.

Timber Harvest and Nutrients

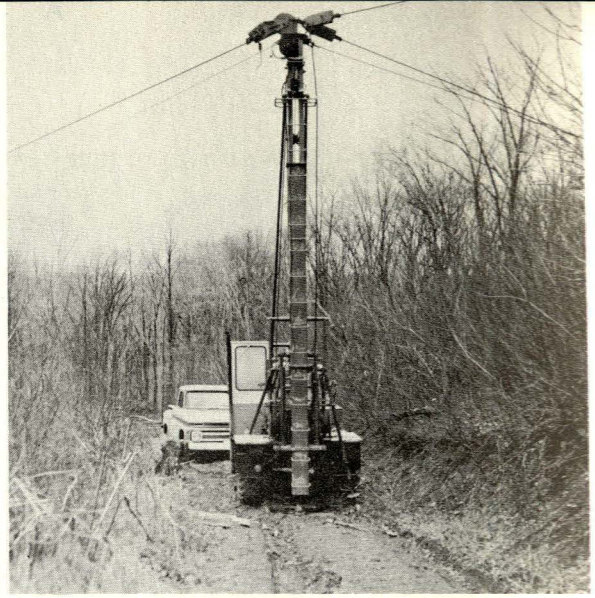
Last year we reported on the controversial question of the draining of nutrients from the forest ecosystem following clearcutting, and told you that our research on this is continuing. During the year, one of our Station scientists reviewed all the evidence relative to the Northeast and his report serves to define the extent and severity of the problem (*Reinhart 1973*). In all the studies so far made, only those in New Hampshire indicate enough nutrient leaching after cutting to pose a problem. And in New Hampshire, the early concern over possible water pollution is giving way to the question of the amount and importance of the loss of nutrients from forest sites within

the ecosystem. Our scientists at Hubbard Brook are now evaluating strip-cutting, one alternative to clearcutting. A watershed is being harvested by cutting one-third of the watershed every other year in a series of 80-foot-wide strips. The interim results of this experiment are encouraging. The maximum nitrate-nitrogen concentration in streamflow during the first 2 years after the start of strip-cutting has been under 3 parts per million. The study is continuing and we will watch further results closely.

Management Options for the Central Appalachians

As stated in our 1971 Annual Report, we set up a multiproject program (NE-MPP-1, Environmental Systems in the Central Appalachians) to develop the well-integrated information and techniques necessary for managing *all* forest resources of the region. The scientists of several disciplines who are working on this program have prepared a paper on "Some Options for Managing Forest Land in the Central Appalachians" that evaluates forest practices in the region for effects on timber, water, visual appeal, and wildlife; separate evaluations are presented for seven different ecosystems within the region. This will soon be published and will provide the forest land manager with the information we have now about the effects of various alternative management practices. It will also show the gaps in available information and help to guide future research.

In November we held an informal evaluation meeting to review the multiproject program. About 30 people attended, representing interested state and federal agencies, universities, environmental groups, and consulting and industrial foresters. We're sure their input will help us conduct a better program. At this evaluation meeting we also demonstrated two cable logging systems that have potential for reducing environmental impact. One is the experimental CHUBALL we described in last year's report; the other a light skyline system manufactured in Europe. Individual researchers have been studying various multiple-use aspects of management; for example, the effects of even-aged management on turkeys



A light cable logging system set up for operation on a ridge-top road. Cable logging reduces the number of skid roads required.

(*Thomas et al. 1973*) and the influence of forest cutting on streamflow (*Patric 1973*). This multiproject program approach is helping our scientists, who have such different training and interests, understand each other's problems and capabilities much better than they could before.

Backcountry Research Program

To bolster research efforts on the effects of recreation in the backcountry of the Northeast, a new program has been developed at Durham, New Hampshire. It is concerned with the impacts of hikers, campers, skiers, and off-road vehicles.

Emphasis is being placed on a consideration of these backcountry areas as discrete ecosystems. The research program will determine: (1) the impact of man on the wildland ecosystem, (2) the capacity of various fragile areas to support use by people, and (3) means of strengthening some aspects of the backcountry ecosystem so that these areas can be utilized to the fullest extent possible and still retain their natural characteristics. Use of both engineering and biological techniques is anticipated.

After the initial analysis of the problem, a two-pronged approach will be used: first, research and development with emphasis on research to aid management decisions; second,

as fundamental questions surface and resources become available, basic studies of some of the processes by which people interact with the wildland ecosystems.

It is expected that a considerable part of the research will be carried out by cooperative efforts with interested groups and academic institutions.

Oak Lumber Drying

Seasoning problems cause major difficulties in marketing and utilization of red and white oak lumber. Both species dry slowly, and they are subject to costly drying degrade unless drying conditions are carefully controlled. A 5-year study conducted in central Pennsylvania (*Beall and Spoerke 1973*) showed that air-drying degrade losses averaged less than 2 percent for 4/4 lumber, and slightly more than 3 percent for 8/4 lumber. Drying season had little effect on degrade losses for 4/4 lumber, but losses for 8/4 red oak stacked in the summer and fall were about double those for lumber stacked in the winter and spring. In contrast, degrade losses for 8/4 white oak were greatest for lumber stacked in the winter. Air-drying time was greatest for both species and both thicknesses when they were stacked in the fall and winter. The active air-drying season was from March through November. Almost no air drying occurred in December, January, and February.

Kiln drying of green white oak resulted in less overall degrade loss than kiln drying of previously air-dried lumber; but for red oak, previously air-dried lumber suffered the least overall degrade loss. Kiln-drying times for previously air-dried lumber were about one-fourth those required for kiln drying green lumber.

Results of this study clearly demonstrate the limitations on air drying during the winter months. The information will be useful to lumber producers and users in production and inventory planning, and in the selection of the most efficient combinations of drying methods.

Computer Simulation Projects Logging System Balance

Logging superintendents recognize the importance of using the proper combination of men and machines to achieve high production and low unit costs. Unfortunately, operators tend to apply static procedures to a wide range of harvesting conditions. Thus, they have a poor chance of achieving maximum efficiency and profit. Only one system is optimal for each logging situation; the problem is to find it.

To solve this problem, a computer simulation program was developed (*Martin 1973*). This simulator can take all forms of logging interrelationships and compute the comparative productive output and costs of each logging system. The program contains sections for all the major logging functions, such as felling, skidding, bucking, loading, and hauling. Allowing time to elapse minute by minute for each productive and delay function, the simulator can generate the time required for each phase of the logging sequence.

Program output data show logging managers the volume and cost differences for different machine and manpower combinations under the same operating conditions. Results pinpoint the least cost system and show the most productive system in terms of volume. The program also shows how each segment of logging is affected by the specified system inputs. Thus managers can determine how to better balance their total operations by changing certain segments of individual logging functions.

Reducing Turnover by Better Employee Selection

Recruiting workers and holding them on the job is a persistent problem for many firms in the wood industry. New employees often quit after working only a few weeks or months. This not only disrupts production but also results in higher operating and administrative costs; the loss when a skilled worker quits may exceed $2,000. Consequently, a study was undertaken to identify the biographic and employment history variables associated with job tenure (*Wolf 1973*). Results indicate that sev-

eral variables, such as friends and relatives employed by the company, housing accommodations, commuting distances, and prior work experience in the wood industry can be used to predict the tenure of job applicants. Once fully identified, such items can be used by employers to select job applicants who have a reasonable chance of developing into stable and productive employees. In contrast, age, marital status, length of service on last job, and other socioeconomic variables commonly used in making hiring decisions were not found to be useful in predicting an applicant's tenure.

Improved Utilization of Low-Grade Hardwood Lumber

Northeastern Station research into utilization of low grades of hardwood lumber has identified new opportunities for the profitable use of these materials. All of the defects in a representative sample of No. 2 Common oak lumber have been recorded for use in the computer simulation of cutting methods (*Lucas and Catron 1973*). We have found that cuttings up to 60 inches in length can be sawn from No. 2 Common lumber with no decrease in overall yield (*Lucas 1973*). The industrial rule of thumb had been to try for nothing longer than 40-inch cuttings.

A new kind of end-glued joint has been developed for the hardwood industry (*Araman 1973*). Called SEM (for Serpentine End Matching), this new curved joint is hidden in the wood grain and allows production of aesthetically pleasing solid wood panels from small pieces of lumber.

Timber Quality Research

A significant proportion of the hardwood timber resource is made up of material that will not qualify as factory class logs. Since the practice of whole tree utilization is becoming more important, the most profitable use of this material must be determined. Green lumber grade yields from subfactory-class logs for 10 important hardwood species have been published (*Hanks 1973*). These lumber grade yields are a necessary input into economic analyses of the alternatives available for converting this class of material into useful products.

A revised guide outlining the basic principles of hardwood log grading has been published (*Rast et al. 1973*). Research results developed since the last revision (*1965*) are incorporated into the handbook. These include a better definition of log end defect evaluation as well as improved illustrations of grading procedures. This guide will be useful for on-the-job training and reference and for formal classroom teaching.

Fair Incentives for Timber Management

Today we are witnessing new interest in action programs designed to improve the timber productivity of private nonindustrial forests, but small private woodland owners remain an apathetic clientele. Few of them believe that investments in forestry are worthwhile. Cash incentive payments apparently offer a means for persuading these owners to practice good timber management. But what constitutes a fair incentive payment? A recent study describes a practical approach to this problem and demonstrates its application in forest stands of upland hardwoods (*Gansner, Herrick, and Larsen 1973*). The suggested incentive payment is based on the differences between discounted costs and returns of deliberate forest management and those of the "harvest and let grow" option.

Regional Opportunities for Timber Management

Recent concern about future supplies of timber has stimulated proposals to increase the amounts of public funds and technical assistance available for timber management. However, few guidelines exist for making optimal use of these funds and services at the local level. Sound strategies for program orientation cannot be chosen until regional opportunities for accelerated management have been clearly defined.

The woodlands of any region exhibit virtually every stage of stand condition and development. A task force of Northeastern Sta-

tion scientists developed a practical guide for sorting this variable resource into well defined units of area that are relevant for the selection, analysis, and evaluation of timber management practices (*Gansner, Barnard, and Gingrich 1973*). The model was applied to a typical problem. Thirty-six management opportunity classes were identified for oak-hickory forests in the hill country of Ohio. The potential impact of two alternative regional programs of intensive management was evaluated (*Gansner and Herrick 1973*). Results indicate that sound silviculture could increase yield values by as much as 60 percent over the next 50 years. Findings have been incorporated into *The Outlook for Timber in the United States* and provide a basis for program planning and legislation needed to balance the Nation's timber budget.

Maple Sap Processing Costs

Maple syrup producers are becoming more aware of the importance of cost control in the production of maple syrup. Further, there is a trend toward larger scale operations that provide the primary source of income to their owners. Little cost information is available to assist syrup producers in cost control measures and to insure a smooth transition to larger scale operations.

One phase of a study on costs of processing maple sap to syrup was to evaluate the efficiency of the evaporators used in terms of heat energy consumed (BTU) per gallon of syrup produced. Research findings revealed that gas-fired evaporators were operating at average BTU efficiency of 65 percent, oil-fired evaporators operated at an average of 55 percent BTU efficiency, and wood-fired evaporators were operating at an average of 30 percent BTU efficiency. These are well below the efficiency ratings published by manufacturers of evaporators. Other critical findings are that, of the three major cost items (capital, labor, fuel), the cost of fuel is the highest—approximately 36 percent as compared to 31 percent for capital, 28 percent for labor and 5 percent miscellaneous costs. The higher cost of fuel is directly related to the low economic efficiency of the evaporators now being used.

Presently, there is considerable interest in developing more efficient methods of processing sap to syrup. This is very critical to the industry at a time when fuel costs are increasing along with other costs of production. These research findings will not only provide maple producers with cost information for use in cost control, but will also serve as basic information for future research and development of more efficient evaporator systems.

PUBLICATIONS

in 1973 by staff members and cooperators of the Northeastern Forest Experiment Station, Forest Service, U.S. Department of Agriculture.

Publications divided by subject. Numbers refer to items in the alphabetical list that follows.

General
38, 61, 62, 81, 91, 131, 160, 161, 162, 163, 180, 199, 201, 239, 240, 241, 245

Environmental Forestry Research
55, 58, 85, 93, 106, 116, 138, 167, 173, 187, 206, 207, 227, 228, 229, 230, 253

Timber Management
1, 5, 7, 8, 9, 10, 17, 18, 19, 26, 27, 30, 37, 43, 50, 51, 53, 60, 61, 62, 65, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 80, 82, 83, 84, 86, 87, 90, 94, 96, 97, 98, 104, 112, 126, 132, 134, 135, 136, 137, 147, 148, 155, 156, 160, 172, 174, 183, 185, 187, 188, 189, 190, 191, 192, 197, 198, 208, 211, 212, 213, 222, 224, 234, 235, 236, 237, 238, 247, 251, 257

Gypsy Moth Research and Development
16, 41, 42, 143, 145, 157, 168, 258

Forest Insects
11, 39, 40, 48, 59, 63, 83, 89, 113, 155, 169, 186, 210, 212, 225, 226, 259

Forest Diseases
21, 22, 23, 57, 58, 69, 85, 95, 111, 113, 116, 117, 118, 119, 120, 121, 146, 186, 202, 203, 204, 209, 210, 246, 250, 254

Wildlife Habitat
18, 103, 177, 179, 193, 194, 227, 228, 229, 230, 231, 232, 233

Forest Recreation
64, 127, 128, 154, 187, 206

Watershed Management
6, 20, 46, 47, 49, 50, 51, 52, 54, 66, 67, 76, 107, 108, 109, 110, 115, 122, 124, 125, 133, 141, 156, 166, 174, 175, 176, 183, 184, 216, 217, 218, 223, 242, 243, 248, 252

Forest Economics and Forest Survey
1, 3, 13, 14, 31, 32, 33, 34, 35, 36, 56, 68, 77, 78, 79, 105, 114, 123, 130, 149, 150, 153, 180, 182, 249

Forest Products Marketing and Utilization
2, 3, 4, 15, 28, 29, 44, 45, 88, 92, 99, 100, 101, 102, 129, 139, 140, 142, 144, 151, 152, 158, 159, 164, 165, 170, 171, 178, 181, 195, 196, 200, 205, 214, 215, 219, 220, 221, 244, 255, 256

Forestry Engineering
24, 25, 164

---

(1) von Althen, F. W.
1973. **Fertilization of juvenile hardwoods.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 183–187.

Plowing and disking the planting site, followed by effective weed control for the first 3 years after planting, were found to be prerequisite to the successful establishment of hardwood plantations in southern Ontario. To increase seedling growth during the critical establishment phase, N-P-K fertilizers were applied to the soil surface at time of planting. However, until more promising results are obtained, fertilization of new hardwood plantations cannot be recommended.

(2) Anderson, R. Bruce.

1973. **Factors influencing the selection of state office furniture.** USDA Forest Serv. Res. Pap. NE-266. 6 p.

Evaluation of the factors influencing the selection of office furniture by nine state governments shows that quality and purchase price have the most important influence on the purchase decision. The intended use of the furniture and the purchasing regulations of the states were key factors in the use of wood furniture.

(3) Anderson, R. Bruce, and William C. Miller.

1973. **Wooden beverage cases cause little damage to bottle caps.** USDA Forest Serv. Res. Note NE-161. 4 p.

Wooden beverage cases cause little damage to aluminum resealable caps during distribution. A study at bottling plants and distribution warehouses showed that an average of 1 bottle out of 4,000 has cap damage. Most of the damage was attributed to handling at the warehouse and in transit. Some recommendations are given for improvement of wooden beverage cases to prevent damage.

(4) Araman, Philip A.

1973. **A new kind of end-glued joint for the hardwood industry.** USDA Forest Serv. Res. Note NE-156. 4 p.

A method has been developed for end- and edge-gluing short pieces of high-value hardwood lumber into long panels, using a curved end joint we call SEM (Serpentine End Matching). Panels containing SEM end joints are aesthetically pleasing and are suited for exposed applications such as in finished furniture.

(5) Armson, K. A.

1973. **Soil and plant analysis techniques as diagnostic criteria for evaluating fertilizer needs and treatment response.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 155–166, illus.

Use of soil and plant analysis techniques must take into account both stage of development and rate of growth of the tree crop and the environmental conditions under which the crop exists. The principles and relationships between plant growth, plant nutrients, and soil nutrients are illustrated. Soil and plant analyses have been used both comparatively and mathematically. The precautions necessary in sampling and use of chemical procedures applied to plots and soils are discussed.

(6) Aubertin, G. M., D. W. Smith, and J. H. Patric.

1973. **Quantity and quality of streamflow after urea fertilization on a forested watershed: first-year results.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 88–100, illus.

Streamflow was analyzed to determine the effects on the quantity and quality of water flowing from a 74-acre calibrated watershed that had been fertilized with 500 pounds of urea per acre. During the first year after fertilization, no change was detected in the quantity of streamflow. Water quality, as determined from analysis of 829 samples, remained high.

(7) Auchmoody, L. R.

1973. **Intensive culture of black cherry.** S. Lumberman 227(2824) : 113–115.

Describes research under way, interim results, and future plans for fertilization and genetic improvement of black cherry at Warren, Pa. Field fertilization trials with young wildland populations and with selected black cherry families both suggest that fertilization will become an important cultural technique in this region.

(8) Auchmoody, L.

1973. **Response of yellow-poplar, red oak and basswood to fertilization in West Virginia.** Agron. Abstr. 1973 Annual Meeting, Las Vegas, Nev. p. 137.

Field fertilization tests were established in northern West Virginia with small sawlog size yellow-poplar, red oak and basswood. Yellow-poplar was the most responsive species, showing consistent basal area response to N. Red oak was less responsive than yellow-poplar, and basswood was unresponsive. For yellow-poplar, critical foliar concentrations were 3.1 percent N and .15 percent P.

(9) Auchmoody, L. R., and S. M. Filip.

1973. **Forest fertilization in the eastern**

United States: hardwoods. *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 211–225, illus.

Attempts to improve growth rates of eastern hardwoods by fertilization date back to the early 1930's. Many reports have shown that many species growing on many different sites are responsive to various fertilizer additives. Unfortunately, however, only a small portion of this information is applicable to eastern hardwood forests.

(10) Auchmoody, L. R., and G. W. Wendel.

1973. **Effect of calcium cyanamide on growth and nutrition of planted yellow-poplar seedlings.** USDA Forest Serv. Res. Pap. NE-265. 11 p., illus.

Calcium cyanamide, a nitrogenous fertilizer that also acts as an herbicide, was evaluated over a 3-year period for use in establishing planted yellow-poplar on an old-field site. Results of this study show that first and second year growth of yellow-poplar can be increased by broadcasting $CaCN_2$ around the seedlings. When applied at rates of 400 to 500 pounds of nitrogen per acre $CaCN_2$ eliminated competing ground cover and supplied nitrogen to the seedlings that promoted vigor and rapid early growth.

(11) Barger, Jack H., Roy A. Cuthbert, and Donald W. Seegrist.

1973. **Statistical correlations between GLC assay and smaller European elm bark beetle bioassay.** J. Econ. Entomol. 66(1): 79–81, illus.

American elm trees, *Ulmus americana* L., were sprayed with methoxychlor by helicopter or mist blower, and twig crotches were collected from sprayed trees for bioassay of *Scolytus multistriatus* (Marsham) and GLC assay. Correlations established between the two assays were dependent on method of application and amount of methoxychlor residue. Correlations were low and variable for helicopter-sprayed trees and high and uniform for mist-blower-sprayed trees.

(12) Barnard, Joseph E., C. Allen Bickford, and Carl E. Mayer.

1973. **Forest survey cubic-foot volume equations.** USDA Forest Serv. Res. Note NE-166. 2 p.

The cubic-foot volume equations used in the regionwide Forest Survey are presented, and their development is discussed. An example of the use of an equation is given.

(13) Barnard, Joseph E., and Teresa M. Bowers.

1973. **A preview of Delaware's timber resource.** USDA Forest Serv. Res. Note NE-159. 3 p.

The recently completed forest survey of Delaware indicated little change in the total forest area since the 1957 estimate. Softwood volume and the acreage of softwood types decreased considerably. Hardwoods now comprise two-thirds of the volume and three-fourths of the forest area. Total average annual growth exceeded removals, but softwood removals exceeded average annual growth by 50 percent.

(14) Barnard, Joseph E., and Teresa M. Bowers.

1973. **A preview of New Jersey's forest resource.** USDA Forest Serv. Res. Note NE-177. 3 p.

The recently completed forest survey of New Jersey indicates that 54 percent of the land area has tree cover on it. Thirty-eight percent of the state is classified as commercial forest land. Total growing-stock volume has increased, although the softwood component of the resource has decreased in both cubic-foot volume and area occupied by the softwood types. Average annual growth for all species combined exceeded timber removals; however, softwood removals exceeded growth by 22 percent.

(15) Beall, F. C., and G. R. Spoerke.

1973. **Degrade of oak lumber as influenced by drying.** Forest Prod. J. 23(11): 25–30, illus.

A study of the drying characteristics of red and white oak lumber in central Pennsylvania showed that drying season had less effect on air-drying degrade losses for 4/4 lumber than for 8/4 lumber. Degrade losses averaged less than 2 percent of lumber value for 4/4 lumber, and slightly more than 3 percent for 8/4 lumber. However, drying seasons greatly affected air drying rates: air-

drying times ranged from 1 month to nearly 6 months for 4/4 lumber, and from about 3 months to more than a year for 8/4 lumber. Kiln drying of green white oak lumber produced less overall degrade loss than kiln drying of air-dry lumber; but for red oak, greater losses occurred in kiln drying green lumber.

(16) Bean, James L.
1973. **The USDA Forest Service gypsy moth research and development program.** W. Forest Insect Work Conf. Proc. 24:5—24, illus.

A five-year R&D program designed to develop, demonstrate, and provide the technology needed to minimize the gypsy moth problem was undertaken by the USDA in 1972. Four USDA agencies participate in this program with the Forest Service responsible for the major research effort. The R&D program has been divided into the following major elements: assessing and predicting population trends and impacts; chemical pesticides; microbials; parasites; predators; and sterile male release.

(17) Beaton, J. D.
1973. **Fertilizer methods and applications to forestry practice.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 55–71.

Although N and P are the nutrients that most frequently increase tree growth and vigor in forest stands of eastern North America, other elements, including K, S, Ca, and Mg, are also beneficial. Most fertilizer products suitable for use in forestry exert considerable influence on the chemical and physical properties of forest soils, mainly through temporary and permanent changes in soil pH. Solubilization of organic matter, release of plant nutrients, and movement of nutrient cations are all affected by fertilizer-induced alterations in soil reaction.

(18) Behrend, Donald F.
1973. **Wildlife management-forest fertilization relations.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 108–110.

There is a dearth of information about comprehensive management systems, and little more than crude speculation about forest fertilization-wildlife management relationships. To elucidate these relationships, studies of fertilization—including various combinations of goals and techniques—should be conducted.

(19) Benzie, John W., Silas Little, and R. F. Sutton.
1973. **The Northeast and Boreal Region.** J. For. 71: 154–158, illus.

One of four papers on the rehabilitation of forest land, this one points out that, of the 435 million acres of commercial forest land in the nineteen northeastern states and adjoining provinces of Canada, possibly 200 million acres need treatment to attain moderate stocking of desirable trees. Causes, nature, and importance of the problem are discussed, as are rehabilitation methods and practices and the research needs.

(20) Berg, William A., and Willis G. Vogel.
1973. **Toxicity of acid coal-mine spoils to plants.** *In* Ecology and reclamation of devasted land. Russell J. Hutnik and Grant Davis (eds.) Vol. I: 57–68, illus. Gordon & Breach, New York.

Toxicity of extremely acid coal-mine spoils to plants is caused primarily by excess soluble Mn and other metals, most probably Al. Manganese toxicity, expressed by chlorosis on the margins of legume leaves, was observed on herbaceous legumes, shrub lespedezas, and black locust grown from seed in extremely acid spoils in the greenhouse and in the field. Spoil pH was useful in predicting Mn toxicity to the legumes, but water-soluble Mn extracted from the spoils was not. Symptoms of Al toxicity were expressed by stubby roots without laterals. One year after extremely acid spoils were mulched with hardwood chips, the pH of the top 30 cm of spoil was raised while total soluble salts and water-soluble Al were reduced.

(21) Berry, Frederick H.
1973. **Decay of oak in Ohio.** Ohio Woodlands 11(4): 12–13, illus.

Heartwood decay, or "heart rot" causes considerable loss in both timber volume and quality in oak forests in Ohio. Twenty-nine species of heart rot fungi were isolated and identified. Although the number of butt

infections was only about half the number of trunk infections, the former accounted for almost two-thirds of the decay volume loss. Fire scars were the most important entry courts for heart rot fungi. Scarlet oak had the most decay, followed by black oak, chestnut oak, and white oak in that order. Several ways of reducing losses from heart rot are enumerated.

(22) Berry, Frederick H.
1973. **Diseases.** *In* Black walnut as a crop. Black walnut symp. USDA Forest Serv. Gen. Tech. Rep. NC-4: 114 p.

Several diseases that can cause considerable damage to black walnut trees are discussed. Walnut root rots are serious in a number of nurseries where black walnuts are grown. Anthracnose is the most serious foliage disease of black walnut, and some methods for its control are suggested. Other diseases discussed include walnut bunch, heart rots, and cankers.

(23) Berry, Frederick H.
1973. **Heart rots of central region hardwoods.** USDA Forest Pest Leafl. 140, 9 p., illus.

Heart rot fungi cause considerable losses in both timber volume and quality in the central hardwood region. These fungi commonly enter living trees through various kinds of wounds. In the central hardwood region, fire scars are the principal entry point for heart rot fungi. Based on the portion of wood decomposed, heart rots are divided into two broad groups—white rots and brown rots. The majority of heart rots in central hardwoods are white rots. Descriptions of the more common heart rot fungi are included in the publication. Although no direct control of heart rots is known, a number of ways in which losses can be reduced are enumerated.

(24) Biller, Cleveland J.
1973. **Match your skidder tires to your machine load.** S. Lumberman 226(2809): 15, 16, 18, illus.

Using tables and the methods discussed in the manuscript, the correct tire size and inflation pressure can be determined for a particular skidder. Tables were prepared for six different makes of skidders common in Appalachia.

(25) Biller, C. J., and L. R. Johnson.
1973. **Comparing logging systems through simulation.** Trans. ASAE 16(6): 1060–63, 1071.

Loggers and especially timber harvesting researchers have needed an analytic method of comparing different logging systems (new and old) without expensive equipment purchases or long-term tests. A mathematical simulation method was developed that compares logging systems for cost and productivity. This simulator has been modified to include skyline systems and costs for one skyline are reported. Simulation results cannot replace actual logging costs, but do provide valuable information at low cost on both experimental and conventional logging systems.

(26) Bjorkbom, John C.
1973. **Response of paper birch seedlings to nitrogen, phosphorus, and potassium.** USDA Forest Serv. Res. Note NE-157. 4 p.

The effects of N, P, and K on the growth of paper birch seedlings were tested in sand culture tests. Each element was tested singly at different levels while holding constant the supply of all other elements. Seedling growth increased with increasing amounts of nitrogen. Three to four percent in the foliage indicated an adequate supply. Seedlings were relatively unaffected by different levels of phosphorus and potassium.

(27) Bjorkbom, John C.
1973. **The effects of various combinations of nitrogen, phosphorus, and potassium on paper birch seedling growth.** USDA Forest Serv. Res. Note NE-158. 4 p., illus.

The combined effects of various concentrations of N, P, and K on the growth of paper birch seedlings were tested in sand culture tests. All other elements were held constant. The best seedling growth and dry weight of foliage generally occurred at concentrations of 400 ppm N and 50 ppm P or 600 ppm N and 75 ppm P. The concentration of K had relatively little effect. The optimum combination was not found but the results suggested that the amount of K should be increased.

(28) Blum, Barton M.

1973. **Relation of sap and sugar yields to physical characteristics of sugar maple trees.** Forest Sci. 19: 175–179.

Relationships of crown size, bole size, competition, and growth to sap-volume yield, sap-sugar concentration, and total sugar yield were examined in sugar maple trees using stepwise regression and convariance analyses. Observations were made on 60 trees in each of three sugarbushes in Vermont. Derived equations were not precise enough for prediction of yields; relation among variables differed among sugarbushes and years. Physical characteristics of individual trees are good criteria for judging potential yield in a broad sense, but past importance placed on them was not justified.

(29) Blum, Barton M.

1972. **Relationship between tree characteristics and maple sugar yields.** Natl. Maple Syrup Dig. 11(3): 15, 17, 19.

Simple correlation coefficients between various characteristics of sugar maple trees and sap sugar concentration, sap volume yield, and total sugar production are given for the 1968 sap season. Correlation coefficients in general indicated that individual tree characteristics that express tree and crown size are significantly related to sap volume yield and total sugar production. However, there was little evidence of a strong relationship between such tree characteristics and sap sugar concentration.

(30) Blum, Barton M.

1973. **Some observations on age relationships in spruce-fir regeneration.** USDA Forest Serv. Res. Note NE-169. 4 p., illus.

Measurement of the ages of seedlings of balsam fir (*Abies balsamea* (L.) Mill.), red spruce (*Picea rubens* Sarg.), and white spruce (*Picea glauca* (Moench) Voss) 15 years after the first harvest of a two-cut shelterwood operation revealed that very few potential crop-tree seedlings in the sample occurred as advance regeneration in the original stand. Relationships among total height, age, and current growth of the samples are reported, as well as the variation in seedling age encountered.

(31) Bones, James T.

1973. **Primary wood-product industries of Southern New England—1971.** USDA Forest Serv. Resour. Bull. NE-30. 17 p., illus.

The result of a complete canvass of the primary wood manufacturers in southern New England, this report contains data about wood production and receipts for the states of the region. Comparisons are made with a similar 1952 survey and trends in industrial wood output are noted.

(32) Bones, James T.

1973. **The timber industries of New Jersey and Delaware.** USDA Forest Serv. Resour. Bull. NE-28. 17 p., illus.

Results of a field canvass of all known primary wood manufacturers that operated in Delaware and New Jersey in 1970. The industrial wood statistics are compared with previous surveys and important trends in industry development are noted. Total roundwood output was down 31 percent in Delaware since 1956, and down 43 percent in New Jersey since 1955.

(33) Bones, James T., and Joseph E. Barnard.

1973. **Land clearing and wood use in Delaware, 1972.** USDA Forest Serv. Res. Note NE-163. 5 p., illus.

Changing land use often results in removal of the existing forest cover. During a resurvey of Delaware's timber resources, a study was made to measure the losses of wood fiber that resulted from forest land clearing. It was estimated that nearly 33 million cubic feet of growing stock was destroyed on the 37,000 acres of commercial forest land that was cleared between 1954 and 1968.

(34) Bones, James T., and James E. Blyth.

1973. **Pulpwood production in the Northeast and North Central States for 1972.** N. Logger 22(4): 14, 22.

Pulpwood production for all states decreased less than 0.5 percent between 1971 and 1972, but in New England total production decreased 11 percent. These statistics and others resulted from a complete canvass of woodpulp mills which is conducted annually by the Forest Service Experiment Stations in the East. The article contains 1972 pulpwood

production statistics for the 21-state area, by states and sources of pulpwood, and the number of mills that were operating.

(35) Bones, James T., and David R. Dickson. 1973. **Pulpwood production in the Northeast, 1971.** USDA Forest Serv. Resour. Bull. NE-29. 18 p., illus.

An annual report based upon canvasses of pulpwood production in the Northeast, containing data about pulpwood production from roundwood in the 14 Northeastern States by counties and species groups, and pulpwood chip production from plant residues. Comparisons are made with the previous year's production data. Trends in pulpwood production for the past 9 years are shown.

(36) Bones, James T., and David R. Dickson. 1973. **Pulpwood production in the Northeast, 1972.** USDA Forest Serv. Resour. Bull. NE-31. 21 p., illus.

An annual report based upon canvasses of pulpwood production in the Northeast, containing data about pulpwood production from roundwood in the 14 Northeastern States by counties and species groups, and pulpwood chip production from plant residues. Comparisons are made with the previous year's production data. Trends in pulpwood production for the past 10 years are shown. Also included is a list of the woodpulp mills that were operating in the region in 1972.

(37) Brett, C. P. 1973. **A multidisciplinary approach to stand-management research in the forest ecosystem.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 36–44, illus.

The ecosystem in which an individual tree exists is not unmanageable. The resources and range of disciplines required to study it and other individual tree ecosystems intensively can be acquired and deployed without many of the difficulties encountered in studying forest ecosystems. Sampling techniques to provide a link between individual trees and the forest stand in which they exist are now being tested.

(38) Brisbin, Robert L., and David L. Sonderman. 1973. **Birch—An American Wood.** USDA Forest Serv. Am. Woods Series FS-221, 11 p.

A revision of the American Woods Series on the three commercially important species of birch. Tree characteristics, geographical distribution, wood properties, and principal uses are illustrated and discussed.

(39) Burns, Denver P. 1973. **The foraging and tending behavior of *Dolichoderus taschenbergi* (Hymenoptera: Formicidae).** Can. Entomol. 105: 97–104, illus.

The foraging and tending behavior of the ant *Dolichoderus taschenbergi* (Mayr) was studied for 5 years in southwestern Pennsylvania. The ant used well-defined foraging trails and avidly collected honeydew from tuliptree scales, pine aphids, and less abundant sources. The ants increased the survival rate of tuliptree scales from 8.2 to 46.8 percent, probably by interfering with the activities of parasites and predators.

(40) Campbell, Robert W. 1973. **The conceptual organization of research and development necessary for future pest management.** *In* Pest management for the 21st century: 23–38, illus. Idaho Res. Found. Nat. Resour. Ser. 2. Univ. Idaho, Moscow.

The complex and evolving question of how best to organize and conduct a program of research and development to cope intelligently with test problems was discussed, and a research and development framework was described.

(41) Campbell, Robert W. 1973. **Forecasting gypsy moth egg-mass density.** USDA Forest Serv. Res. Pap. NE-268. 19 p., illus.

Models developed for forecasting gypsy moth egg-mass density indicate several naturally occurring processes that could terminate a massive outbreak of this pest, but they do not indicate mechanisms sufficient to change this population system from the INNOCUOUS phase to the OUTBREAK one. Some of the implications arising from the above conclusions are discussed.

(42) Campbell, Robert W.

1973. **Numerical behavior of a gypsy moth population system.** Forest Sci. 19: 162–167, illus.

The numerical behavior of a gypsy moth population system observed in eastern New England between 1911 and 1931 is described. Rates of change in egg mass density from years (n) to ($n + 1$) were related to rates of change in density from years ($n - 1$) to (n) and to an index of the density level of the overall population system, termed "zone density." When zone density was high, individual populations tended to increase to and maintain high density levels. When zone density was low, individual populations tended to achieve and maintain low densities. Numerically unstable populations between years ($n - 1$) to (n) tended to remain numerically unstable from years (n) to ($n + 1$).

(43) Carl, Clayton M., Jr., John R. Donnelly, and Boyd W. Post.

1973. **Effect of moisture and fertilizer on sugar maple seedlings.** Univ. Vt. Agric. Exp. Sta. Res. Rep. MP79. 6 p.

Sugar maple seedlings were grown in old field soil under combinations of three moisture levels and three nutrient levels. Increased watering significantly increased root dry weight, shoot dry weight, shoot height and shoot diameter. None of these measurements of seedling growth were significantly stimulated by fertilization nor was there any statistically significant interaction between moisture levels and nutrient levels. The higher moisture levels also produced seedlings with lower root-shoot ratios. Since it is generally recommended that high quality outplanting stock have high root-shoot ratios, this might affect the survival of outplanted sugar maple seedlings and should be tested.

(44) Church, Thomas W., Jr.

1973. **The significance of sweep in Appalachian hardwood sawlogs.** USDA Forest Serv. Res. Note NE-172. 4 p., illus.

Sweep is one of the major stem form defects in hardwood sawtimber. Some sweep is removed during bucking. But we found sweep of 2 inches or more on 17 percent of the 4,510 logs measured at Appalachian sawmills. Volume deductions for sweep scaled at least 10 percent in 1 of every 7 sample logs and at least 15 percent in 1 of every 9 sample logs. Reduction in the severity of sweep might be obtained by applying the simple rules outlined for buckers.

(45) Coleman, Ronald E., and Hugh W. Reynolds.

1973. **Sawing SHOLO logs: three methods.** USDA Forest Serv. Res. Pap. NE-279. 5 p., illus.

Three different methods of sawing the SHOLO log were compared on a board-foot yield basis, using sawmill simulation. All three methods of sawing were simulated on the same sample of logs, eliminating differences due to sampling. A statistical test was made to determine if there are any real differences between the board-foot yields. Two of the sawing methods provided about the same board-foot yields; one provided about 40 percent less.

(46) Curtis, Willie R.

1973. **Effects of strip mining on the hydrology of small mountain watersheds in Appalachia.** *In* Ecology and reclamation of devastated land. Russell J. Hutnik and Grant Davis (eds.). Vol. I: 145–156. Gordon & Breach, New York.

Strip mining of small mountain watersheds results in higher stream turbidities and increased peak flow rates. The increased turbidities may be a temporary phenomenon. Streams draining the strip-mined watersheds generally have an increased load of minerals, especially sulphate, magnesium, and calcium.

(47) Curtis, Willie R.

1973. **Moisture and density relations on graded strip-mine spoils.** *In* Ecology and reclamation of devastated land. Russell J. Hutnik and Grant Davis (eds.). Vol. I: 135–144. Gordon & Breach, New York.

Past research indicates that compaction during spoil-bank leveling results in less infiltration and decreased tree growth where ridges had been. This paper reports the first-year results of a study to determine the disposition of subsurface moisture on leveled spoil

banks in western Kentucky and to determine whether the moisture conditions can be changed through scarification and vegetative treatments. A significant difference was noted in density and available moisture between former ridge and valley locations. The lowest moisture values were noted in the surface foot. Surface scarification apparently has not affected moisture or density.

(48) Cuthbert, R. A., J. H. Barger, A. C. Lincoln, and P. A. Reed.

1973. **Formulation and application of methoxychlor for elm bark beetle control.** USDA Forest Serv. Res. Pap. NE-283. 6 p., illus.

Methoxychlor deposits on elms sprayed with several formulations of methoxychlor by helicopter, hydraulic sprayer, or mistblower were compared using GLC assays and elm bark beetle bioassays. Hydraulic sprayers gave the heaviest and most uniform deposits. Helicopter deposits were lightest. The formulation of methoxychlor did not significantly affect the deposits.

(49) Czapowskyj, Miroslaw M.

1973. **Book review: Bodengeographie (Geography of soils), by Robert Ganssen in cooperation with Zlatko Gracanin (Koehler Publ. Co., Stuttgart).** Soil Sci. 116 (6): 453–454.

A review of a 1972 book in German that "bridges the gap between geomorphology and soil science."

(50) Czapowskyj, Miroslaw M.

1973. **Establishing forest on surface-mined land as related to fertility and fertilization.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 132–139.

On strip-mined lands, most spoils are not hostile to planted trees. Nearly all elements essential for plant growth were found in the spoils; their concentrations depend on lithology, acidity, and the rate and degree of spoil weathering. Planted and seeded forest trees respond strongly to application of N and P both singly and in combination. Certain spoils will respond to K application. Extreme acidity and high concentrations of Mn, Fe, Zn, S, and Al are major factors limiting plant growth on coal-breaker refuse; but such areas are a small portion of the total area of disturbed land. Application of lime alleviates these problems.

(51) Czapowskyj, Miroslaw M.

1973. **Performance of red pine and Japanese larch planted on anthracite coal-breaker refuse.** *In* Ecology and reclamation of devastated land. Russell J. Hutnik and Grant Davis (eds.). Vol. II: 237–245. Gordon & Breach, New York.

Red pine (*Pinus resinosa* Ait.) and Japanese larch (*Larix leptolepis* (Sieb. and Zucc.) Gord.) seedlings were planted on coal-breaker refuse with all combinations of two levels of lime, two levels of fertilizer, and four mulch treatments. The site was highly unfavorable as a medium for tree growth, and the 4-year results show that: lime application was essential for adequate survival and establishment of both species; neither mulch nor fertilizer treatments contributed substantially to tree establishment and height growth; and after 4 years, the pH values are still neutral in the top 4 in. of the limed plots.

(52) Czapowskyj, Miroslaw M., and Edward A. Sowa.

1973. **Lime retention in anthracite coal-breaker refuse.** USDA Forest Serv. Res. Note NE-154. 4 p.

Hydrated lime was applied to extremely acid anthracite coal-breaker refuse at rates of 2.5 and 5.0 tons per acre. The lime raised the pH to neutral range, and this range was still in evidence 7 years after treatment. The pH readings decreased with the depth of the refuse profile, and below 9 inches they approximated those of the control plots. The 2.5-tons-of-lime-per-acre treatment was almost as effective as the 5.0-ton treatment. Application of lime in establishing vegetation on coal-breaker refuse is recommended and encouraged.

(53) Dale, Martin E.

1973. **Growth and yield functions for thinned upland oak stands.** Diss. Abstr. 34(1): 10B.

There is a lack of information about the quantitative and qualitative growth and yield expectations from managed oak stands. Data were obtained and equations developed which

quantify physical growth and yield relationships for upland oak stands over a wide range in site quality, age, and stocking conditions after initial thinning. The equations form the basis of a computer program which generates predictions of growth and yield using only the input variables of initial stand age, basal area, number of trees, and site index.

(54) Davis, Grant.
1973. **Comparison of fall and spring planting on strip-mine spoils in the bituminous region of Pennsylvania.** *In* Ecology and reclamation of devastated land. Russell J. Hutnik and Grant Davis (eds.). Vol. I: 525–538. Gordon & Breach, New York.

To evaluate fall versus spring planting of 10 coniferous tree species and 5 hardwood shrub species, experimental plantings were established over a 2-year period on 7 graded strip-mine spoils. In general, initial tree survival was better with spring planting than with fall planting, especially on the more acid sites. Shrubs survived well with both spring and fall planting on the better sites, but spring planting of shrubs was more successful on the more acid sites. Season of planting had no significant effect on fifth-year height of either trees or shrubs.

(55) Demeritt, M. E., Jr.
1973. **Prospects for selecting and breeding trees resistant to deicing salt.** NE. Forest Tree Improv. Conf. Proc. 20: 130–140.

There is abundant evidence on the damaging effects of deicing salts on the roadside plant biota in comprehensive literature reviews. Trees may be injured by salt spray or salt-contaminted soil and are generally much more sensitive to salt-contaminated soil than grasses, although there is considerable variation in tolerance among and within species. Species, varieties, and clones recommended for highway and street plantings should be considered for investigation as to their tolerance to deicing salts. Low-cost procedures will have to be developed and tested to evaluate tolerance to salt spray and salt-contaminated soil. Straightforward selection and breeding programs could be used to develop resistant or tolerant clones or varieties for urban and highway plantings.

(56) Dempsey, Gilbert P.
1973. **Toward growth in productivity.** Forest Prod. J. 23(4): 12–14.

Forest resources are declining in quality while costs of extraction increase. Innovative processes are needed, but also thought, research, and action to improve productivity in the wood-using industry. With the recent price increases in lumber and wood products, and the increasing attention that the Cost of Living Council has focused on the wood industry, managers may well find areas in which research and action can be profitable.

(57) Dessureault, M., A. E. Rich, and A. L. Shigo.
1973. **Mapping of total nitrogen in decayed wood associated with *Fomes connatus* and *Polyporus glomeratus* in Acer rubrum.** Phytopathology 63: 200–201 (Abstr.)

Two columns of decayed wood, one associated with *Fomes connatus* and the other with *Polyporus glomeratus*, were mapped systematically for nitrogen (N) using a micro-Kjeldahl method. The results suggest that some N had been added to the decaying wood during the discoloration and decay process, making it more susceptible to further degradation.

(58) Dochinger, Leon S.
1973. **Christmas trees and air pollution.** Horticulture 51(12): 40–42, illus.

Chronic air pollution is debilitating groves of Christmas tree plantings in parts of Maryland and West Virginia. Air pollution symptoms are presented for conifer species affected by aerial phytotoxicants. Possible solutions are suggested for alleviating effects of air pollutants on Christmas trees.

(59) Donley, David E.
1973. **The European pine shoot moth—10 years later.** Ohio Woodlands 11(3): 18–20, illus.

In a study of damage to red pine (*Pinus resinosa*) plantations by the European pine shoot moth (*Rhyacinia buoliana*) it was found that the long-term effect of shoot moth damage is only negligible at worst and may be insignificant in plantations managed for poles and lumber production.

(60) Donnelly, R. Jr., and H. W. Yawney.
1973. **Some factors associated with vegeta-**

tively propagating sugar maple by stem cuttings. The Int. Plant Propagators Soc. Comb. Proc. 22: 47–66.

Sugar maple cuttings root best if collected when elongation of the current year shoots has ceased and leaves appear mature in size and color. Cuttings should be as long and as thick as possible. Response to rooting hormones was mixed: in some trees low concentrations of hormones stimulated rooting, but for other trees hormone concentration was inhibitory. Overwintering survival appears to be correlated with vigor of rooted cuttings.

(61) Doolittle, W. T.

1973. **The hardwood futures: A look at the resource and management.** First Annu. Hardwood Symp. Proc.: 22–29. Hardwood Res. Counc., Statesville, N.C.

Commercial forest land in the East decreased by nearly 5 million acres between 1962 and 1970, and a similar loss is predicted for each future decade. Growth of larger sized and better quality hardwoods barely equalled removals. Sweetgum, oak, ash, walnut, and cherry are in critical supply in the South, and yellow birch in the North. Intensive research, management, and utilization will be required.

(62) Doolittle, Warren T.

1973. **Opening remarks on behalf of the U.S. Forest Service.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 1–2.

(63) Doskotch, Raymond W., Adel A. Mikhail, and Sujit K. Chatterji.

1973. **Structure of the water-soluble feeding stimulant for *Scolytus multistriatus*: a revision.** Phytochemistry 12: 1153–1155.

The feeding stimulant for the smaller European elm bark beetle has been revised from (+)-catechin 5-β-D-xylopyranoside to (+)-catechin 7-β-D-xylopyranoside.

(64) Echelberger, Herbert E., and George H. Moeller.

1973. **Toward a better understanding of recreational boating in the Adirondack Lakes Region.** Water Resour. Bull. 9(4): 1266–1272.

Results of a study to determine the relationship between physical characteristics of Adirondack lakes and variations in peak boat-use intensity indicated that 69 percent of variation in peak use can be accounted for by the number of public and commercial boat-launching facilities per mile of lake shoreline. Other lake characteristics related to peak boat use were: the number of commercial overnight accommodations available, number of boat slips, lake size, and miles of lake shoreline. Lake characteristics not related to peak use were: accessibility, configuration, tent spaces available, surrounding landscape quality, volume of traffic, and availability of other lakes. This information should provide recreation managers and planners with a better understanding of factors related to variation in peak boating-use periods.

(65) Ellis, R. C., and F. W. von Althen.

1973. **Fertilization of adult and juvenile hardwoods in Ontario.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 174–182, illus.

Fertilization and thinning are being used to rehabilitate hardwood woodlots of southern Ontario for the production of high-grade hardwood lumber. Variable conditions of tree quality, species composition, and age necessitate evaluation of experimental treatments on the basis of individual tree responses. A method is described for selecting trees and allocating them to treatments according to a competition index.

(66) Federer, C. Anthony.

1973. **Annual cycles of soil and water temperatures at Hubbard Brook.** USDA Forest Serv. Res. Note NE-167. 7 p., illus.

Soil temperatures in the Hubbard Brook Experimental Forest in central New Hampshire decline very slowly from December to March and are restricted from falling below 0°C. by insulation of snow and organic matter. Soil in the hardwood forest on a moderate south slope warms rapidly in the spring leafless period after snowmelt and reaches a maximum temperature in early August that averages 17.5°C. near the surface and 12.5°C. at 91-cm depth. The soil cools to nearly isothermal conditions at 11°C. in October. The mean annual cycle of soil temperature near the surface corresponds closely to that of air

temperature under the canopy, except in winter. Stream temperatures are about the same as soil temperature at a depth of 31 cm. throughout the year. Windthrow mounds are cooler than uniform slopes in winter and warmer in summer. Simultaneous soil temperatures at different locations in the forest generally differ by no more than 2°C. at any given depth.

(67) Federer, C. A.
1973. **Forest transpiration greatly speeds streamflow recession.** Water Resour. Res. 9(6): 1599–1604, illus.

Streamflow recessions from a 42-ha forested watershed in New Hampshire are greatly affected by transpiration. In the dormant season, recession flow continues for many days at rates around 1 mm/day, while in the growing season, streamflow rate declines in several days to less than 0.05 mm/day. Elimination of transpiration by cutting and herbiciding a 16-ha watershed changed the rate of its summer recession from the rapid decline associated with transpiration to the slow recession characteristic of no transpiration.

(68) Ffolliott, Peter F., and David P. Worley.
1973. **Forest stocking equations: their development and application.** USDA Forest Serv. Res. Pap. RM-102. 8 p.

A number of forest land uses require planning information about the aerial distribution of different forest vegetation. This publication describes how to inventory a forest tract and combine aerial distribution data with the presently collected timber data in a single inventory. The stocking equations developed through this procedure can be used to help evaluate land treatment potential, to determine treatment feasibility on a single management unit, and as a basis for setting operating priorities on a number of management units.

(69) Filip, Gregory M., A. L. Shigo, M. C. Hoyle, and A. E. Rich.
1973. **Effect of fertilizer salt accumulation and low relative humidity on development of stem lesions on yellow birch seedlings.** USDA Plant Dis. Rep. 57: 499.

Basal stem lesions on seedlings of yellow birch (*Betula alleghaniensis*) became a serious problem when seedlings were grown under laboratory conditions for research purposes. Results of the study showed that any number of micoorganisms were capable of invading the tissues that were first weakened by a high accumulation of fertilizer salts that occurred more commonly when the relative humidity was low.

(70) Filip, Stanley M.
1973. **Cutting and cultural methods for managing northern hardwoods in the northeastern United States.** USDA Forest Serv. Gen. Tech. Rep. NE-5. 8 p., illus.

The steady increase in multiple use of northern hardwood forests in the Northeast makes it urgent for managers to keep selected stands highly productive. Maintaining a balanced structure by selection cutting is advisable for sugar maple and other shade-tolerant species. Stand harvesting in small blocks, strips, or patches works well for the highly valued yellow birch, paper birch, and white ash. Although the accepted cultural methods such as seedbed preparation, thinning, and improvement operations are helpful, new cultural methods must be developed to increase yields and shorten rotations.

(71) Filip, Stanley M., and W. B. Leak.
1973. **Northeastern northern hardwoods.** *In* Silvicultural systems for the major forest types of the United States. USDA Agric. Handb. 445, p. 75–77.

The authors discuss variations in forest type, soils, and elevation for northeastern northern hardwoods and then recommend appropriate silvicultural methods for this commercially important forest type.

(72) Fortescue, J. A. C., and D. Burger.
1973. **Landscape geochemistry and forest fertilization.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 226–233, illus.

An introduction to the subject of landscape geochemistry, focusing attention on relationships between landscape geochemistry and forest fertilization. An orientation landscape geochemistry project is described, with special reference to a method for determining the element status of forest trees and stands, which is believed to be independent of with-

in-season or season-to-season variation in chemical composition.

(73) Frank, Robert M.

1973. **The course of growth response in released white spruce—10-year results.** USDA Forest Serv. Res. Pap. NE-258. 6 p., illus.

White spruce trees released on three or four sides outgrew untreated controls and those released on one or two sides by two to one in a 10-year study. The released trees appeared to have a slightly longer growing season.

(74) Frank, Robert M., and John C. Bjorkbom.

1973. **A silvicultural guide for spruce-fir in the Northeast.** USDA Forest Serv. Gen. Tech. Rep. NE-6. 29 p., illus.

A practical guide to the silvicultural treatment of spruce-fir stands for timber production in New England and New York. Both even-aged and uneven-aged management are considered, covering both the establishment of new stands and the culture of existing stands. Includes a set of prescriptions describing specific treatments for a range of stand conditions and management objectives.

(75) Gabriel, William J.

1973. **Morphological differences between black maple and sugar maple and their hybrids.** NE. Forest Tree Improve. Conf. Proc. 20: 39–45, illus.

Typical *saccharum* and *nigrum* specimens are characterized by well-defined morphological differences. The two taxa should be treated as subspecies in a sugar maple complex because of the ease with which they can be artificially hybridized and the numerous forms that appear with intermediate bark characters. No introgression with respect to bark characteristics was observed and the leaves of artificially-produced hybrids favored the *saccharum* female in outline and the *nigrum* male in pubescence.

(76) Gagnon, J. D.

1973. **Environmental aspects of sewage-derived fertilizers.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 101–107, illus.

A 10-year-old white spruce plantation established on sandy soil gave a 30-percent height-growth response over control trees 4 years after application of 500 pounds per acre of sewage sludge. This result is a challenge to foresters to turn what has always been a liability into a commercial asset without contributing to water pollution.

(77) Gansner, David A., Joseph E. Barnard, and Samuel F. Gingrich.

1973. **Identifying regional opportunities for accelerated timber management.** USDA Forest Serv. Res. Pap. NE-251. 6 p., illus.

Describes a procedure for identifying regional opportunities for accelerated timber management and demonstrates its application. Results provide a basis for rational choices among alternative management strategies and permit meaningful micro- and macro-evaluations of treatment response.

(78) Gansner, David A., and Owen W. Herrick.

1973. **The timber-supply potential of intensive management in upland oak forests of Ohio.** USDA Forest Serv. Res. Pap. NE-271. 8 p., illus.

Two alternative programs of intensive timber management were defined for Ohio's oak-hickory forests. Their potential was evaluated by comparing the expected yields and yield values of each program with those expected from a continuation of current management practices. Neither program would produce large increases in timber yield, but the expected gains in yield value would be impressive.

(79) Gansner, David A., Owen W. Herrick, and David N. Larsen.

1973. **Deriving fair incentives for management of hardwood timber stands.** USDA Forest Serv. Res. Pap. NE-263, 4 p.

The authors present a practical method for deriving timber-management incentive payments and demonstrate its application in forest stands of upland hardwoods. The suggested incentive payment is based on the differences between costs and returns of deliberate forest management and the "harvest and let grow" option.

(80) Garrett, Peter W., Ernst J. Schreiner, and Harry Kettlewood.

1973. **Geographic variation of eastern white pine in the Northeast.** USDA Forest Serv. Res. Pap. NE-274. 14 p., illus.

Eastern white pine is the most valuable conifer in the Northeast, and its large botanical range has provided ample opportunity for the development of ecôtypes. Provenance plantings in nine states provided information on variability within the species and recommendations for moving seed from one region to another. Good growth was obtained on southern Appalachian sources moved as far north as central Pennsylvania. Needle length, branching habit, cone production and other characters are discussed.

(81) Garrett, Peter W.

1973. **Dr. Ernst Jefferson Schreiner.** NE. Forest Tree Improve. Conf. Proc. 20: 3–16, illus.

A tribute to Dr. Schreiner, founder and for 20 years executive secretary of NEFTIC, who in 1972 retired from the Forest Service after a long and distinguished career as forest geneticist. Laudatory comments from coworkers throughout the world are appended.

(82) Garrett, Peter W.

1973. **Northeastern Forest Tree Improvement Conference cumulative index, 1953-1972.** USDA Forest Serv. NE. Forest Exp. Sta. 73 p.

A cumulative index of reports published in the NEFTIC proceedings during the 20-year period 1953-72, arranged in author index, species index, and subject index.

(83) Garrett, P. W., and R. M. Rauter.

1973. **Geographic variation in resistance to white pine weevil** *(Pissodes strobi* Peck.) **by eastern white pine,** (*Pinus strobus* L.). Can. Entomol. 105(2): 347–351, illus.

Weevil damage on 12 sources of eastern white pine was measured. Differences between sources at age 13 were significant, but all sources were heavily weeviled. It is doubtful that sources resistant to the white pine weevil will be located.

(84) Garrett, Peter W., and Robert Zahner.

1973. **Fascicle density and needle growth responses of red pine to water supply over two seasons.** Ecology 54(6): 1328–1334, illus.

Ontogeny of terminal growth in red pine suggests that the growing season can be divided into three 2-month periods. During the middle period (June-July) mitotic activity at the shoot apex initiates dwarf primordia for the subsequent seasons's foliage; thus preconditioning one year has a strong effect on next year's growth. Shoot extension was governed equally by conditions of the middle period of the previous year and of the early period of the current year. Fascicle density was regulated only by conditions of the early period of the current year.

(85) Gerhold, H. D., E. H. Palpant, W. M. Chang, and M. E. Demeritt, Jr.

1972. **Tubing fumigation method for selection of pines resistant to air pollutants.** Mitt. Forstl. Bundes-Versuchsanst. Wien 97:511–520.

Special selection methods are required for breeding programs that improve the resistance of pines to air pollutants. A fumigation method has been developed for evaluating resistance of large numbers of trees to damage by ozone and sulfur dioxide, without destroying any of them. Needle fascicles of seedlings in a nursery are exposed to acute dosages in clear plastic tubing, important environmental variables are monitored, and damage is evaluated within a few days. Equipment and personnel needs are described and illustrated. Objective measurements of various symptoms are integrated in damage-rating scales that are suitable for quantitative analysis. Current experiments are designed to estimate genetic parameters, using biparental progenies of *Pinus sylvestris* that include intra- and inter-population matings.

(86) Gibbs, Carter B.

1973. **Northeastern spruce-fir.** *In* Silvicultural systems for the major forest types of the United States. USDA Agric. Handb. 445, pp. 71–72.

The author describes variations in the spruce-fir type in northeastern U.S. as well as seed production. Clear cutting, selection, and shelterwood cutting are recommended for various conditions which occur in this type.

(87) Gibbs, Carter B., and James B. Carlaw.

1973. **The New England spruce-fir seed or-**

chard program. 10th Lake States Forest Tree Improve. Conf. and 7th Cent. States Forest Tree Improve. Conf. joint proc: 53–56. USDA Forest Serv. N. Cent. Forest Exp. Sta. Gen. Tech. Rep. NC-3.

A brief history of the spruce-fir seed orchard program, with a discussion of some of the problems encountered and suggestions for improvement in the organization and conduct of tree-improvement programs.

(88) Gibbs, Carter B., and H. Clay Smith.

1973. **Cambial dieback and taphole closure in sugar maple after tapping.** USDA Forest Serv. Res. Note NE-155. 4 p.

Dead cambial tissues adjacent to tapholes were found to be elliptical and to average 1.6 inches in length and 0.2 inch in width. Chemical and physical treatments designed to stimulate the growth of callus tissues surrounding tapholes were not successful. Nearly all the tapholes, both treated and untreated, had closed after three growing seasons.

(89) Gibson, Lester P.

1973. **An annotated list of the Cicadellidae and Fulgoridae of elm.** USDA Forest Serv. Res. Pap. NE-278. 5 p.

This annotated list includes 87 cicadellid and 13 fulgorid species that were found on and probably feed on elm to some extent. Thirteen of the cicadellid species listed are known vectors of virus or mycoplasmalike diseases of plants. Also, 18 cicadellid genera and one fulgorid genus contain known vectors of virus or mycoplasmalike diseases.

(90) Gladstone, William T., and Richard L. Gray.

1973. **Effects of forest fertilization on wood quality.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 167–173, illus.

Recent studies demonstrate an increase in the uniformity of wood as a result of fertilization. An increase in cell-wall thickness of earlywood fibers and a simultaneous thinning of latewood fiber walls were induced in fertilized red pine and Douglas-fir. Wood quality, for the pulp and paper industry, is generally enhanced by such uniformity. Strength properties of pulps produced from fertilized trees are as good as or better than those of pulps from unfertilized trees.

(91) Gochenour, Donald L., Jr., and Leonard R. Johnson.

1973. **Reliable results from stochastic simulation models.** USDA Forest Serv. Res. Pap. NE-277. 5 p., illus.

Reliable results from simulation models depend on how long the model runs. Construction of confidence intervals about critical output parameters makes it possible to determine when results are reliable. The amount of computer time needed to obtain these results will depend on model variability, prescribed width of the confidence interval, and level of confidence of the simulation model.

(92) Goho, Curtis D., and A. Jeff Martin.

1973. **Sawlog sizes: a comparison in two Appalachian areas.** USDA Forest Serv. Res. Note NE-160, 5 p., illus.

Frequency distributions of log diameter and length were prepared for eight Appalachian hardwood species. Data obtained in Ohio, Kentucky, and Tennessee were compared with information collected previously from West Virginia and New England. Except for red oak, significant regional differences were found.

(93) Gordon, Barry, and Thomas G. Lambrix.

1973. **The battle of Lynn Woods.** Nat. Hist. 82 (9) : 76–81, illus.

Lynn Woods, near Boston, is a 2,000 acre municipally-owned recreational forest and watershed area. In the late 1950's plans were initiated to route a section of Interstate 95 through the Woods. Local opposition to the plans formed and a controversy, lasting several years, ensued. Participants in the controversy exhibited a range of attitudes and pursued various strategies. In 1972, the proposal for the road was abandoned, and the City of Lynn is applying for a grant to improve and maintain Lynn Woods as a recreational facility.

(94) Graber, R. E., W. B. Leak, and D. F. Thompson.

1973. **Maximum ages of some trees and shrubs on Mount Washington.** N.H. Forest Notes 115: 23–24, illus.

The longevity and species of trees and shrubs encountered on an elevational transect of Mt. Washington are discussed. These data are useful in assessing long-term changes in vegetation and plant succession.

(95) Gregory, Garold F., Thomas W. Jones, and Percy McWain.

1973. **Pressure injection of methyl 2-benzimidazole carbamate hydrochloride solution as a control for Dutch elm disease.** USDA Forest Serv. Res. Note NE-176. 9 p.

A preliminary evaluation of the effectiveness of injecting methyl 2-benzimidazole carbamate hydrochloride solution into elms for prevention or cure of Dutch elm disease is reported. Symptom development was diminished or prevented in elms injected with fungicide before inoculation. Symptom development was arrested in all crown-inoculated diseased trees injected with the high and medium concentration of the fungicide and in bole-inoculated diseased trees injected with the high concentration of the fungicide when not more than about 50 percent of the crown was symptomatic.

(96) Grisez, Ted J., and Maurice R. Peace.

1973. **Requirements for advance reproduction in Allegheny hardwoods—an interim guide.** USDA Forest Serv. Res. Note NE-180, 5 p.

Reproduction tallies on 65 areas planned for clearcutting were compared with reproduction 2 to 4 years after cutting. As a result, we recommend that 70 percent of the area be stocked with at least 5,000 black cherry seedlings or 30,000 seedlings per acre of desirable species before cutting. If this requirement had been used on these 65 areas, the proportion of regeneration successes would have been raised from 54 to 92 percent.

(97) Hacskaylo, Edward.

1973. **Carbohydrate physiology of ectomycorrhizae.** Chapter 6. *In* Ectomycorrhizae. pp. 207–230. Academic Press, New York.

The author discusses host-dependent translocation of carbon compounds, carbohydrates and mycorrhizae formation, utilization of carbon compounds by ectomycorrhizal fungi, and carbohydrate transformation. He also supplies a list of useful references.

(98) Hacskaylo, E.

1973. **Dependence of mycorrhizal fungi on hosts.** Torrey Bot. Club Bull. 100(4): 217–223, illus.

In nature, mycorrhizal fungi depend on carbohydrates supplied primarily by their hosts. Amino and other organic acids, the M-factor, and possibly other root secretions are metabolized by the fungi. Certain ectendomycorrhizal fungi are readily cultured; their nutritional requirements are probably similar to ectomycorrhizal fungi. Endomycorrhizal fungi are apparently obligate parasites. However, in balanced systems of reciprocal exchanges of metabolites they are not considered to be pathogenic toward their hosts.

(99) Hafley, W. L., and Hansen, K. W.

1973. **Optimum sequence of cutting bills.** Forest Prod. J. 23(8): 26–29, illus.

A crosscut saw operator in the rough end of a furniture plant can effectively consider only a limited number of cutting lengths at a time. Eight sequencing rules were developed that can be used without the aid of an electronic computer. These rules determine, for a given cutting bill, what should be an original combination of five lengths, and in what sequence the remaining lengths should be assigned to the crosscut sawyer to minimize the lumber input requirements of a given grade. Furniture plants using these rules can greatly improve the efficiency of their raw material utilization.

(100) Hanks, Leland F.

1973. **Green lumber grade yields for subfactory class hardwood logs.** USDA Forest Serv. Res. Pap. NE-256. 8 p.

Data on lumber grade yields for subfactory class logs are presented for ten species of hardwoods. Logs of this type are expected to assume greater importance in the market. The yields, when coupled with lumber prices, will be useful to sawmill operators for developing log prices in terms of standard factory lumber.

(101) Hanover, S. J., W. L. Hafley, A. G. Mullin, and R. K. Perrin.

1973. **Linear programming and sensitivity analysis for hardwood dimension production.** Forest Prod. J. 23(11): 47–50, illus.

Improving hardwood dimension stock yield is a continuing problem facing the furniture industry. This study has developed a linear programming model that is designed to determine the least-cost grade mix of lumber input for a dimension cutting order, and a solution technique for the model which involves sensitivity analysis.

(102) Hansen, Bruce G.
1973. **Natural versus artificial: where do we stand?** Proc. Cornell Sch. for Christmas Tree Growers: 85–96.

An analysis of the competition between the natural and artificial Christmas trees is presented. Included is a discussion of the historical development of both natural and artificial Christmas trees, the characteristics of natural and artificial tree users, and the factors influencing tree purchase. Brief mention is also made of future expectations and actions which must be taken by members of the natural tree industry to improve their competitive position.

(103) Healy, W. M., and J. W. Thomas.
1973. **Effects of dusting on plumage of Japanese quail.** Wilson Bull. 85: 442–448.

Many authorities have suggested that dust-bathing by birds helps control ectoparasites and promotes cleanliness, but experimental verification of these ideas is meager, and the importance of dusting sites is questioned by wildlife habitat managers. During 17 days we supplied dusting material (fine soil) to 40 Japanese quail, and kept another 40 without access to dust. Sample feathers from dusting birds showed better barb alignment and less dandruff. The most noticeable effect of dusting was the drying and fluffing of the down. Until more is known about the function of dusting, we do not recommend habitat management to provide dusting sites.

(104) Hejnowicz, Z, and J. A. Romberger.
1973. **Migrating cambial domains and the origin of wavy grain in xylem of broad leaved trees.** Am. J. Bot. 60: 209–222.

Anatomical analysis of wavy-grained xylem samples of *Fraxinus, Acer,* and *Betula* reveals a strong underlying pattern of orientational domains—local areas in the cambium within which the orientation of pseudotransverse divisions of fusiform initial cells is predominantly unidirectional rather than random. Domain patterns and their movements were delineated by classifying and mapping ray splitting and uniting events in temporal series of tangential sections of terminal late xylem. The domain patterns move slowly upward, preceding the similarly outlined, but noncoincident, grain pattern.

(105) Herrick, Owen W.
1973. **Delimiting regional sub-areas for studies of timber-resource-based activity in the Northeast.** Forest Sci. 19: 180–189, illus.

The Northeast is classified into homogeneous sub-areas based upon a variety of physical, economic, and demographic variables postulated to reflect conditions underlying timber-based activity in the region. These environments in which timber exists were differentiated so that subsequent inquiry into regional problems regarding timber-resource-based activity could be made area-specific. Factor and cluster analyses provided an efficient and objective procedure for classifying this extensive and complex region.

(106) Herrington, L. P., and G. M. Heisler.
1973. **Microclimate modification due to power transmission rights of way.** *In* Power lines and the environment. Cary Arboretum, N.Y. Bot. Gard., p. 36–57.

Rights of way for power transmission are common in megalopolis and may affect the local environment of many people. If tall vegetation is removed on rights of way, changes will occur in microclimate, in water budgets and in stream temperatures. Many of the changes are minimal, and changes in the design of the rights of way can lessen any adverse impacts.

(107) Hornbeck, James W.
1973. **The problem of extreme events in paired-watershed studies.** USDA Forest Serv. Res. Note NE-175. 4 p., illus.

In paired-watershed studies, the occurrence of an extreme event during the after-treatment period presents a problem: the effects of treatment must be determined by using greatly extrapolated regression statistics. Several steps are presented to help insure

careful handling of extreme events during analysis and reporting of research results.

(108) Hornbeck, James W.

1973. **Storm flow from hardwood-forested and cleared watersheds in New Hampshire.** Water Resour. Res. 9(2): 346–354, illus.

Changes in storm flow as a result of forest clearing by cutting of trees and subsequent applications of herbicides were determined for a small mountainous watershed in New Hampshire. The maximum increase in individual quickflow was 30 mm for the summer streamflow season and just over 50 mm during spring snowmelt. Mean quickflow changes were much lower. The relatively small amount of forest clearing currently taking place in New England headwaters should not increase downstream flood potential.

(109) Hornbeck, James W., and C. Anthony Federer.

1973. **Forests and floods.** N.H. Forest Notes 117: 18–21, illus.

A computer model is used to demonstrate the role of forest vegetation in relation to two flood-producing rains that occurred in New Hampshire during late June and early July 1973. Because of frequent rains in the months preceding the two storms, evapotranspiration from the forest was ineffective in creating soil moisture deficits. Thus the storms quickly raised streams to flood stage. Forest cutting had little effect on flood volumes since differences in soil-moisture deficits were small between cutover and undisturbed areas.

(110) Hornbeck, James W., and Robert S. Pierce.

1973. **Potential impact of forest fertilization on streamflow.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 79–87, illus.

Forest fertilization may cause a decline in quantity of streamflow by stimulating additional leaf surface area and root occupancy, thus increasing water losses to transpiration and interception. Water quality may be affected by application of fertilizers directly into stream channels and by an increase in the amount of nutrients transported to the stream by subsurface flow. The use of gaged watersheds seems to be the best method for quantifying the potential impact of forest fertilization on streamflow.

(111) Houston, David R.

1973. **Diebacks and declines: diseases initiated by stress, including defoliation.** Int. Shade Tree Conf. Proc. 49: 73–76.

This paper summarizes the author's concepts of the relationships of environmental stress and attack by organisms of secondary action to the dieback and decline diseases of forest trees. The results of recent studies by the author and his colleagues on the physiology and ecology of maple and oak declines, and some implications and potential uses of these results are presented.

(112) Hoyle, M. C.

1973. **Nature and properties of some forest soils in the White Mountains of New Hampshire.** USDA Forest Serv. Res. Pap. NE-260. 18 p., illus.

Forested podzol soils in the White Mountains of New Hampshire have developed in granitic, glacial material. They are coarse textured, acidic, and infertile. As a result of the latter condition, these soils can sustain a forest, but that forest is not healthy and vigorous.

(113) Hubbard, Harry B., Jr., and Franklin B. Lewis.

1973. **A spray tower for the application of microbial aerial sprays.** USDA Forest Serv. Res. Pap. NE-249. 8 p., illus.

An experimental spray tower for the application of aerial sprays is described. The construction, operation, and preliminary calibration are detailed.

(114) Hughes, Jay M., and Boyd W. Post.

1973. **Economic considerations in forest fertilization.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 45–54.

Forest fertilization is considered in the context of: (1) the process of fertilization and forest production related to economic analyses; (2) recent ideas for economic analyses of forest fertilization; (3) additional thoughts on economic rationalization of forest fertilization; and (4) identification of research targets for forest fertilization.

(115) Hutnik, Russell J., and Grant Davis (eds.).

1973. **Ecology and reclamation of devastated land.** Vol. I, 538 p; Vol. II, 504 p. Gordon & Breach, New York.

Proceedings of a N.A.T.O. Advanced Study Institute on the ecology and revegetation of drastically disturbed areas held at The Pennsylvania State University, University Park, Pa., August 3-16, 1969.

(116) Jensen, Keith F.

1973. **Response of nine forest tree species to chronic ozone fumigation.** USDA Plant Dis. Rep. 57: 914–917.

Yellow-poplar, green ash, white ash, sycamore, red maple, silver maple, sugar maple, black walnut, and European black alder seedlings were fumigated with 30 pphm ozone for 5 months. Significant reductions in growth of sycamore, sugar maple, and silver maple were found. The fumigated seedlings also tended to lose their leaves sooner than unfumigated seedlings. The relationship between these findings and sensitivity classifications based on symptom development are discussed.

(117) Jensen, Keith F., Frederick W. Bender, and Roberta G. Masters.

1973. **A two-cell chamber for measuring gas exchange in tree seedlings.** USDA Forest Serv. Res. Note NE-178. 3 p., illus.

A two-celled chamber for measuring gas exchange in tree seedlings is described. Temperature is controlled within ± 0.5° C by means of a copper coil. The two cells are independent of one another, and one cell can be used as a preconditioning cell while gas exchange measurements are being made in the second cell.

(118) Jensen, Keith F., and Roberta G. Masters.

1973. **Effect of defoliation on carbohydrate content of yellow-poplar seedlings.** USDA Forest Serv. Res. Note NE-179. 2 p.

Sixty yellow-poplar seedlings were divided into two groups. One group was defoliated twice, and the second group served as the control. Three months after the second defoliation there was no difference in carbohydrate content in either stems or roots between the defoliated and undefoliated seedlings.

(119) Jensen, Keith, F., and Bruce R. Roberts.

1973. **Effects of *Fusarium* canker on translocation in yellow-poplar seedlings.** Physiol. Plant Pathol. 3: 359–361, illus.

Yellow-poplar seedlings inoculated with *Fusarium solani* were exposed to $^{14}CO_2$, and the ^{14}C activity was measured 24 h later. *Fusarium* cankers did not cause an accumulation of photosynthate in the phloem tissue near the infection site. The inoculated seedlings contained more ^{14}C activity than the uninoculated seedlings, suggesting a greater photosynthetic assimilation of $^{14}CO_2$ by the infected seedlings.

(120) Jones, Thomas W.

1973. **Killing the oak wilt fungus in logs.** Forest Prod. J. 23(11): 52–54.

Several countries will not import oak logs and lumber from the United States for fear of introducing the oak wilt disease organism *Ceratocystis fagacearum* (Bretz) Hunt. Treatments have been developed to kill the organism in logs: by heating the logs in hot air at 43°C for 48 hours or 54°C for 24 hours or by immersing them in hot water at 43°C for 48 hours or 49°C for 12 hours. These treatments may make possible less stringent restrictions on the export of oak.

(121) Jones, Thomas W., Garold F. Gregory, and Percy McWain.

1973. **Pressure injection of solubilized benomyl for prevention and cure of oak wilt.** USDA Forest Serv. Res. Note NE-171. 4 p.

A preliminary evaluation of the effectiveness of injecting solubilized benomyl into oaks for prevention or cure of oak wilt disease is presented. Symptom development was greatly reduced or prevented in trees injected with fungicide before inoculation. Symptom development was markedly arrested in diseased trees by fungicide injected before more than 10 percent of the crown was wilted, but treatment of trees with more advanced disease symptoms was not effective.

(122) Kardos, L. T., and W. E. Sopper.

1973. **Effect of land disposal of wastewater on exchangeable cations and other chemi-**

cal elements in the soil. *In* Recycling treated municipal wastewater and sludge through forest and cropland. Pa. State Univ. Press, University Park, Pa. p. 220–231.

Chemical changes in the soil as a result of wastewater applications might adversely affect both soil structure and fertility. In forest areas studied the treatment increased exchangeable Mg, exchangeable Na, and exchangeable Ca (all mostly in the upper soil), had little effect on exchangeable K and H, and increased exchangeable Mn in the deeper layers. However, all changes have been small and appear to pose no problems for the future.

(123) Kingsley, Neal P.

1973. **The volume of selected hardwood species suitable for turnery bolts in Maine, 1970.** USDA Forest Serv. Res. Note NE-165. 5 p.

During the last Forest Survey of Maine, data were collected about the four hardwood species—paper birch, yellow birch, sugar maple, and beech—that are used by turneries. Analysis of the data showed that only about 18 percent of the volume of growing stock in trees 8 inches dbh and larger in these species is acceptable for turning bolts, according to the criteria used.

(124) Kochenderfer, J., and R. Lee.

1973. **Indexes to transpiration by forest trees.** Ecol. Plant. 8 (2) : 175–184.

Five indexes to the transpiration rates of forest trees were tested for consistency among four deciduous species and one coniferous species. The phytometer, quick-weighing, leaf disc, water stress, and stomatal indexes were remarkably consistent among the species. Black cherry (*Prunus serotina*) transpired at the highest rate per unit area of leaf surface in all of the tests, at different times during the growing season, and under a variety of environmental conditions. The differences among the other species were less clearly defined.

(125) Kochenderfer, James N.

1973. **Root distribution under some forest types native to West Virginia.** Ecology 54(2) : 445–448, illus.

Strip-mine high walls and road cuts, less than 2 years old, were used to observe root distribution in several soil and forest types common to north-central West Virginia. Seventy-seven to 89 percent of all the observed root endings were found in the upper .6 m of soil; the highest percentages occurred in the northern hardwood type. The number of roots was greatest in coarse soil and decreased as the soil texture became finer.

(126) Krause, H. H.

1973. **Forest fertilization in eastern Canada, with emphasis on New Brunswick studies.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 188–205, illus.

Although the allowable cut is far in excess of wood consumption in eastern Canada, a strong interest in forest fertilization developed during the 1960's. Main emphasis was placed on experimentation with fertilizers on small experimental plots, and major research programs were developed by the Pulp and Paper Research Institute of Canada, the Canadian Forestry Service, provincial governments, and universities. Although few results have been published, it has become clear that N shortage is commonly limiting growth in pole-size and maturing conifer stands, and that substantial growth increases can be obtained with addition of N.

(127) LaPage, W. F.

1973. **Growth potential of the family camping market.** USDA Forest Serv. Res. Pap. NE-252. 25 p.

A study of the camping market's short-term growth potential based upon interviews with the heads of 2,003 representative American households. The study estimates the size of the potential camping market and divides it into three segments: those families with a high, medium, and low propensity to become campers. The developed camping market is also divided into an active and an inactive segment, determined by camping participation during the 12 months preceding the survey. The total camping market is estimated to include 12.6 million active camping families, 9 million inactive, and 10 million potential camping families. Regional distributions

and characteristics of each segment are described.

(128) LaPage, Wilbur F.
1973. **New Hampshire's commercial campgrounds.** N.H. Forest Notes 115: 20–22, illus.

Traces industry growth since 1955, when there were 13 camping enterprises, to 1971 when over 200 were in business. Describes trends in facilities, services, and methods of operation. Presents information on success /failure rates for enterprises by counties, industry problems, and economic importance of the industry to the state.

(129) Large, Hollis R., and Richard E. Frost.
1973. **Quality distribution of pallet parts from low-grade lumber.** USDA Forest Serv. Res. Pap. NE-284. 8 p., illus.

More efficient use can be made of pallet material if high-quality parts are used in exposed or outside locations. An assessment of pallet-part quality showed that selective placement of parts can be achieved utilizing existing raw material mixes.

(130) Larsen, David N., and David A. Gansner.
1973. **Explaining the forest product selling behavior of private woodland owners.** USDA Forest Serv. Res. Pap. NE-257. 4 p., illus.

A multiple-variable screening technique, AID, was used to explain the forest-product-sales behavior of private woodland owners. Results provide a basis for policy-related inferences and suggest an optimal strategy for encouraging sales of forest products.

(131) Larson, Edwin vH.
1973. **An editors' notebook for authors.** USDA Forest Serv. Calif. Reg. 25 p.

A training guide containing excerpts from the Editors' Notebook published for in-service use by the Northeastern Station.

(132) Leak, W. B.
1973. **Species and structure of a virgin northern hardwood stand in New Hampshire.** USDA Forest Serv. Res. Note NE-181. 4 p., illus.

Virgin northern hardwoods in the Bowl, a natural area in the White Mountain National Forest in New Hampshire, exhibit a limited number of species, large sizes in all key species except beech, a full understory, and a well-developed diameter distribution.

(133) Leonard, R. E., and C. A. Federer.
1973. **Estimated and measured roughness parameters for a pine forest.** J. Applied Meteorol. 12: 302–307, illus.

A topographic map of the upper surface of the canopy of a red pine (*Pinus resinosa*) plantation was drawn from 275 canopy heights measured on a grid of 0.9 x 1.5 m. The roughness parameter z_0 and zero-plane displacement d of the stand were estimated from the canopy map data, using both Kung's logarithmic formula and Lettau's equation for obstacle size and shape. These values were compared with measured z_0 and d from wind and temperature profiles in near-neutral conditions.

(134) Little, Silas.
1973. **Eighteen-year changes in the composition of a stand of *Pinus echinata* and *P. rigida* in southern New Jersey.** Torrey Bot. Club Bull. 100(2): 94–102, illus.

In recent years some ecologists have questioned the applicability of the succession concept to the New Jersey Pine Barrens. The data in this paper cover the 18-year changes in composition of one old-field pine stand and the changes in three other pine stands monitored for 7 to 21 years. Reported changes validate the concept of directional and predictable succession in the Pine Barrens, and also show the effects of an overstory thinning and of three winter fires on succession.

(135) Little, Silas.
1973. **Survival, growth of loblolly, pitch, shortleaf pines established by different methods in New Jersey.** Tree Planters' Notes 24(4): 1–5.

There has long been confusion about how much care should be practiced in establishing trees. In a study comparing direct seeding and planting of 1-0 and 2-0 stock by center-hole, poor-slit, and good-slit methods, planted trees grew slightly faster than those from direct seeding, and trees recovered remarkably well from distortion of root systems in planting—so there was little effect of planting

method on survival and growth after 5 or 10 years. 1-0 stock planted in slits can be recommended for establishing these species on similar sandy sites.

(136) Little, Silas.

1973. **Use of fire—comments from the Northeast.** J. For. 71: 633–634, illus.

Comments follow a paper on using fire in southern forests. In the Northeast both research on using fire and application of prescribed burns began many years ago in two sections: the pitch-shortleaf pine type of New Jersey and the loblolly pine type of Maryland. In recent years studies have been started or made in some other sections. In spite of certain handicaps, fire is one tool in managing vegetation. It might be used in some types to favor certain stand compositions, and in many types to provide grassy openings or to favor certain wild flowers.

(137) Little, Silas, Donald E. Beck, and Lino Della-Bianca.

1973. **Eastern white pine.** *In* Silvicultural systems for the major forest types of the United States, USDA Agric. Handb. 445: 73–75.

The distribution of white pine, its place in succession, the requirements for successful establishment of seedlings, and the role of diseases or insects in modifying success of silvicultural systems are described. Clearcutting in blocks or strips, seed-tree cuttings, shelterwood or group-selection cuttings have all been successful at times in regenerating white pine. Conditions where each type of cutting is suitable are discussed. Shelterwood cutting is considered the most versatile system.

(138) Long, A. J., H. D. Gerhold, and M. E. Demeritt, Jr.

1973. **Metropolitan tree planters survey: initial results.** Pa. State Univ. Sch. Forest Resour. Res. Pap. 41, 14 p.

A survey of tree planting by municipalities, counties, and state highway agencies was started in October 1972. The information gathered is being used to design a practical data system dealing with ornamental and shade trees planted in metropolitan regions. The number of questionnaire respondents and the number of trees planted are correlated with populations of the states. It is estimated that $12,000,000 per year is invested in purchasing and planting trees in the metropolitan areas of the Northeastern region of the United States.

(139) Lucas, Edwin L.

1973. **Long length cuttings from No. 2 Common hardwood lumber.** USDA Forest Serv. Res. Pap. NE-248. 5 p., illus.

Long length cuttings (up to 60 inches) are obtainable in abundance from No. 2 Common oak lumber. Cutting for the maximum area of clear one face (C1F) parts 18 to 60 inches in length, we found that 46 percent of all the cuttings were 36 inches long or longer. The recovery of the long length cuttings did not reduce the overall yield of parts produced from the lumber. Computer simulation of conventional rough mill practices was based on a detailed analysis of 4,500 board feet of No. 2 Common oak lumber.

(140) Lucas, Edwin L., and Leathern R. R. Catron.

1973. **A comprehensive defect data bank for No. 2 Common oak lumber.** USDA Forest Serv. Res. Pap. NE-262. 8 p., illus.

Computer simulation allows low-cost evaluation of rough-mill cut-up procedures. A defect data bank has been developed to provide input for such simulations. It contains detailed data on 637 No. 2 Common oak boards, including a description of each defect (location, size, and type) and the length and width of the board, all recorded on data processing cards. Although compiled from oak boards, the data can be used for most species of No. 2 Common lumber graded by standard rules.

(141) Lull, Howard W.

1971. **Runoff from forest lands.** *In* Man's impact on terrestrial and oceanic ecosystems. W. H. Matthews, F. F. Smith, and E. D. Goldberg (eds.) p. 240-251. The MIT Press, Cambridge, Mass.

Forests cover about one-fourth of the world's land surface and constitute the areas of greatest precipitation, runoff, and potential sedimentation. This paper describes successively the relationships of forest conditions and treatment to water yield, floods, and ero-

sion and sedimentation. Sediment, the principal pollutant from forest land, is intimately tied to runoff.

(142) McCay, Roger E., and Paul S. DeBald.
1973. **A probability approach to sawtimber tree-value projections.** USDA Forest Serv. Res. Pap. NE-254. 9 p., illus.

The authors present a method for projecting hardwood sawtimber tree values, using tree-development probabilities based on continuous forest inventory (CFI) data, and describe some ways to use the resulting value projections to assemble management-planning information.

(143) McCay, Roger E., and William B. White.
1973. **Economic analysis of the gypsy moth problem in the Northeast. I. Applied to commercial forest stands.** USDA Forest Serv. Res. Pap. NE-275, 9 p., illus.

A method of calculating immediate and future losses caused by the gypsy moth is presented, using examples of pulpwood and sawtimber stands. Discounting of future losses to evaluate their cost in terms of current expenditure is explained. The effect of infestation on forest management is discussed and a format is given for considering control decisions.

(144) McGinnes, E. A., Jr., and K. Y-t Wu.
1973. **Intra-incremental chemical studies of ring shake in scarlet oak.** Wood Sci. 5(4): 287–294.

Tangential ring shake is a problem defect in hardwood trees because it is very difficult to identify and evaluate in the standing tree. A study of the chemical properties of wood within a ring shake zone of a single scarlet oak tree has shown an abnormal distribution of chemical components which may weaken the wood structure and be one cause of separation.

(145) McManus, Michael L.
1973. **The role of behavior in the dispersal of newly hatched gypsy moth larvae.** USDA Forest Serv. Res. Pap. NE-267. 10 p., illus.

Study of the behavior of newly hatched gypsy moth larvae showed that they are well adapted for airborne dispersal. Hatching, moving off the egg mass, and dropping on silken threads—which makes them susceptible to being transported by the wind—are described. Larval activity depends on temperature and relative humidity.

(146) McWain, Percy, and Garold F. Gregory.
1973. **A benomyl-derived fungitoxicant for tree wilt disease control.** USDA Forest Serv. Res. Note NE-162. 3 p.

Methyl 2-benzimidazolecarbamate (MBC) was derived from benomyl, a relatively new broad-spectrum systemic fungicide. MBC • HCl solutions have been found to be fungitoxic, stable, suitable for injection into trees, and effective in wilt disease control.

(147) Mader, Donald L.
1973. **Fertilizer needs and treatment responses for wood fiber production: field assessment.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 140–154, illus.

Successful use of fertilizers depends on (1) accurate assessment of inherent productivity potential of the site, (2) determination of nutrient status and needs on the site, and (3) accurate prediction of response to increments of fertilizer added. Soil analysis has not been developed successfully for diagnosis of needs or responses. Extensive test-plot studies for various sites are needed to provide information for developing foliar or soil-based diagnostic systems.

(148) Marquis, David A.
1973. **Cherry-maple.** *In* Silvicultural systems for the major forest types of the United States. USDA Agric. Handb. 445, p. 78–80.

Those silvicultural systems that appear to be biologically feasible for the cherry-maple or Allegheny hardwood type are described, and the biological factors that control the choice of silvicultural options are discussed to aid the resource manager in prescribing appropriate treatments for this forest type.

(149) Marquis, David A.
1973. **Factors affecting financial returns from hardwood tree improvement.** J. For. 71(2): 79–83.

A preliminary economic analysis of hardwood tree improvement suggests that tree improvement is most likely to be profitable for hardwood species that grow rapidly, produce large quantities of seed, and have higher-than-average market values. Black cherry and paper birch were attractive tree-improvement investments, but very large genetic gains would be required to justify costs for red oak. A second finding was that tree improvement would pay only when combined with a program of intensive silviculture.

(150) Marquis, David A.
1973. **Pennsylvania's Allegheny hardwood forests.** Pa. Forests 63(4): 88–89, 108–112, illus.

Before settlement the main Allegheny Plateau forests were white pine, hemlock-beech, and beech-maple. From 1800 to about 1890 there was scattered, sporadic harvesting of selected larger trees; then from 1890 to 1920 most of the plateau was clearcut. This and subsequent fires favored hardwoods. Restrictions on hunting plus heavy forest cutting produced a deer irruption that peaked about 1940. Overbrowsing and small deer size show continuing overpopulation. Much of the area is now under sustained-yield management but adequate regeneration is often lacking.

(151) Martin, A. Jeff.
1973. **Computer simulation as a low-cost approach to logging system balance.** Forest Ind. 100(9): 52–54, illus.

A computer simulation model (being developed at the Forest Products Marketing Laboratory in Princeton, West Virginia) for evaluating logging system balance is discussed. An example representing a fairly typical Appalachian logging operation is presented as an illustration of what can be learned by using the simulator. The initial system is also evaluated under a variety of modifications (additional skidders, trucks, etc.) and the results are compared in terms of production and cost per thousand board feet.

(152) Martin, A. Jeff, and Paul E. Sendak.
1973. **Operations research in forestry: a bibliography.** USDA Forest Serv. Gen. Tech. Rep. NE-8. 90 p.

This annotated bibliography is a compilation of selected literature sources that deal with the application of operations research to forestry situations. Included among the techniques are decision theory, mathematical programming, input-output analysis, simulation, PERT, queuing models, etc. The sources are listed alphabetically by author; also included is a keyword index.

(153) Mendel, Joseph J., Ted J. Grisez, and G. R. Trimble, Jr.
1973. **The rate of value increase for sugar maple.** USDA Forest Serv. Res. Pap. NE-250. 19 p., illus.

Presents financial-maturity information for sugar maple, based on tree-growth and tree-quality data collected in Pennsylvania and West Virginia. Detailed rates of value increase and dollar value increase to be expected for a 10-year period are exhibited. Marking guides in the form of financial-maturity diameters are developed. The effects on financial maturity of operating at different levels of conversion costs and changing costs and prices are analyzed.

(154) Moeller, George H., and John Engelken.
1973. **Fishermen expectations and pay-lake profits.** USDA Forest Serv. Res. Pap. NE-264. 5 p., illus.

Personal interviews with licensed fishermen in central New York State were used to determine characteristics of fishermen who are willing to pay to fish. Willingness to pay was related to aspects of the fishing experience that most strongly influenced fishing enjoyment. Sixty-two percent of the respondents expressed a willingness to pay for a quality fishing experience. Study results suggest that much instability in the pay-lake fishing market may be due to the failure of individual operators to adequately consider all of the costs involved in providing quality fishing experiences.

(155) Mott, D. G.
1973. **Future pest management systems.** *In* Pest management for the 21st century—a symposium. Idaho Res. Found. Nat. Rep. Ser. 2, p. 73–92.

The development of a system for insect management is described. An example from larch

bud moth data is employed to illustrate the approach and the advantages a systems model affords for planning pest control strategy.

(156) Murphey, Wayne K., R. L. Brisbin, and A. P. Binotto.

1973. **Tracheid properties of red pine stem and crown wood from trees irrigated with sewage plant effluent.** Pa. State Univ. Agric. Exp. Sta. Bull. 789, 22 p., illus.

Knowledge of changes in wood properties is essential to complete evaluation of the effects of sewage-effluent irrigation on tree growth. In this study plantation red pines were irrigated with varying amounts of effluent during the growing season for four years. The tracheid dimensions (length, diameter, and cell wall thickness) of wood in the live crown of the treated trees increased significantly, but the stem wood was generally less affected. Red pine maintained satisfactory wood properties with low rates of effluent irrigation; however, when large amounts of effluent must be disposed of, a species more tolerant of wet sites would be more desirable.

(157) Neely, Robert D., and Robert W. Campbell.

1973. **A system for gathering small-mammal mortality data.** USDA Forest Serv. Res. Pap. NE-280. 6 p., illus.

As an aid to studying vertebrate predators of the gypsy moth, a radio telemetry system was designed to detect the death of small mammals and facilitate recovery of the remains. An intraperitoneally implanted radio transmitter is triggered by the drop in body temperature when the animal dies. The device was tested in white-footed mice.

(158) Nevel, Robert L., Jr.

1973. **Factors affecting the use of hardwood flooring in urban rehabilitation.** USDA Forest Serv. Res. Pap. NE-273. 7 p.

The continued use of hardwood flooring in urban rehabilitation is being threatened. A study of the influences that determine the choice of flooring indicates that economic, physical, or technological factors dominate. Most factors affecting the use of hardwood flooring are related to cost, availability, and compatibility. Of these factors, time and cost of installation are considered to be most limiting. Product modification, changes in the distribution and supply system, and a well-rounded marketing and merchandising program by the wood flooring industry are recommended.

(159) Nolley, Jean W.

1973. **Christmas tree marketing: A bibliography.** Am. Christmas Tree J. 17(2): 13–17.

Lack of knowledge about or access to production and marketing information perpetuates inefficiences in individual Christmas tree operations and within the industry as a whole. Use of such information will assist Christmas tree producers, wholesalers, and retailers in making realistic decisions on production and marketing practices, and place the rurally-oriented Christmas tree industry on a stronger economic base.

(160) Northeastern Forest Experiment Station.

1973. **Forest fertilization symposium proceedings.** USDA Forest Serv. Gen. Tech. Rep. NE-3. 246 p.

A report on the Forest Fertilization Symposium held 22-25 August 1972 at Warrensburg, N.Y., planned by the Northeastern Forest Soils Conference, sponsored by the Canadian Forestry Service and the Northeastern Forest Experiment Station, and hosted by the State University of New York College of Environmental Science and Forestry. Contains 25 papers presented at the Symposium.

(161) Northeastern Forest Experiment Station.

1973. **George D. Aiken Sugar Maple Laboratory.** USDA Forest Serv. NE. Forest Exp. Sta.

A brochure describing this new laboratory at Burlington, Vermont, and the research program being carried on there to promote the production and marketing of maple syrup and other maple products.

(162) Northeastern Forest Experiment Station.

1973. **1972 at the Northeastern Station.** 37 p., illus. USDA Forest Serv. NE. Forest Exp. Sta.

A summary of research activities and accomplishments in timber management, forest insects and diseases, forest economics, watershed management, forest products utilization, forest survey, forest recreation, environmental forestry research, wildlife habitat, forest engineering, and forest products marketing. Annotated list of publications.

(163) Northeastern Forest Experiment Station.

1973. **A tree hurts, too.** 28 p., illus. USDA Forest Serv. NE. Forest Exp. Sta.

Well illustrated with color sketches, this shows how a tree reacts to a wound, and the complex sequence of events and organisms in the processes that lead to discoloration and decay in a living tree. Based on the research of Alex L. Shigo.

(164) Nyland, Ralph D.

1973. **Center of gravity for tree-length hardwood sawlogs.** AFRI State Univ. N.Y. Res. Note No. 9, 2 p., illus.

Some logging equipment designs require information on log center of gravity in addition to log size and weight. Measurements from 118 trees were used to develop a prediction equation for the center of gravity of tree-length hardwood logs. Using the equation, AFRI researchers prepared a table showing the center of gravity for tree lengths from 20 to 60 feet.

(165) Nyland, Ralph D.

1973. **Weight scaling for tree-length hardwood sawlogs in New York.** AFRI State Univ. N.Y., Res. Rep. No. 14, 7 p., illus.

When some northeastern sawmills began to buy tree-length logs on the basis of load weight, each mill used its own conversion factor. Suppliers and researchers soon recognized the need for a standard weight-scaling system. Prediction equations were developed to give estimated load volumes from known load weights and numbers of logs. Load volume tables were prepared from the equations for both the Doyle and International log rules.

(166) Patric, James H.

1973. **Deforestation effects on soil moisture, streamflow, and water balance in the central Appalachians.** USDA Forest Serv. Res. Pap. NE-259. 12 p., illus.

Streamflow increased 10 inches annually and soil moisture was greater throughout the growing season on two cleared watersheds compared with a forested control. The water balance equation was solved for transpiration with sufficient sensitivity to show the effect of leaf growth.

(167) Payne, Brian R.

1973. **The twenty-nine tree home improvement plan.** Nat. Hist. 82 (9): 74–75, illus.

Trees add to the dollar value of residential properties. A parcel of open land suitable for development was estimated by professional appraisers to be worth nearly 30 percent more when partially wooded. Trees were estimated by realtors and homeowners to add as much as $4,300 to the value of homes on half-acre lots in Amherst, Massachusetts.

(168) Payne, Brian R., William B. White, Roger E. McCay, and Robert R. McNichols.

1973. **Economic analysis of the gypsy moth problem in the Northeast. II. Applied to residential property.** USDA Forest Serv. Res. Pap. NE-285. 6 p., illus.

Guidelines are presented for determining dollar losses in residential property values from tree mortality caused by the gypsy moth. The method is based on an earlier study in Amherst, Massachusetts, of the contribution of trees to property values. For each target area, the method requires data on property value, lot size, and number of trees 6 inches dbh and larger for a sample of residential properties. Also required are predictions of tree mortality from a gypsy moth attack.

(169) Peacock, J. W., R. M. Silverstein, A. C. Lincoln, and J. B. Simeone.

1973. **Laboratory investigations of the frass of *Scolytus multistriatus* (Coleoptera: Scolytidae) as a source of pheromone.** Environ. Entomol. 2(3): 355–359, illus.

The frass of virgin female *Scolytus multistriatus* (Marsham) evokes an excited turning reaction from walking male beetles in a laboratory olfactometer; frass from virgin males or mated beetles is relatively inactive. Walk-

ing virgin-female beetles are less responsive than males to virgin-female frass. A pentane extract of virgin-female frass elicits the same response from male beetles as an equivalent amount of frass.

(170) Pendleton, Thomas H., and Lawrence D. Garrett.

1973. **Structure of an urban Christmas tree market.** USDA Forest Serv. Res. Pap. NE-270. 6 p., illus.

The retail Christmas tree market in Winston-Salem, N.C. was studied 3 years. Types of retailers and their sales are described. Best sales were made by dealers who had lots on heavily traveled streets in business districts, had ample parking facilities, advertised, and displayed their trees well.

(171) Pendleton, Thomas H.

1973. **Research needs in workmen's compensation.** Forest Prod. J. 23(3): 11–12, illus.

The economic impact of high premiums paid by wood-using firms for workmen's compensation insurance causes numerous problems which affect the efficiency of wood industries. Research is needed to determine the seriousness of these problems and how workmen's compensation laws might be changed to solve them. Six problem areas are identified.

(172) Philbrook, James S., James P. Barrett, and William B. Leak.

1973. **A stocking guide for eastern white pine.** USDA Forest Serv. Res. Note NE-168. 3 p., illus.

A stocking chart for eastern white pine is presented and described. The chart shows basal areas and numbers of trees by mean stand diameter, representing the upper limit in stocking for practical management (A curve) and minimum stocking for full site utilization (B curve).

(173) Pinchot Institute.

1973. **The Pinchot Institute system for environmental forestry studies.** USDA Forest Serv. Gen. Tech. Rep. NE-2. 60 p., illus.

A system for planning and administering research was developed and organized from three different perspectives—a social-need viewpoint, a supply-response viewpoint, and an environmental effect viewpoint. A series of diagrams are used to show how to formulate and evaluate problems identified by the system.

(174) Plass, William T.

1973. **Genetic variability in survival and growth of Virginia pine planted on acid surface-mine spoil.** *In* Ecology and reclamation of devastated land. Russell J. Hutnik and Grant Davis (eds.). Vol. I: 493–507. Gordon & Breach, New York.

Fifty-seven open pollinated Virginia pine progeny from 10 natural stands in Tennessee and Kentucky evaluated under field and greenhouse conditions showed that genetic variability influenced survival and growth on an extremely acid spoil. Large variations occurred between progeny from individual trees within the same stand, and there were differences between stands. Tissue analysis of greenhouse-grown seedlings on the same spoil related growth to nutrient uptake, and showed significant differences between progeny for Mg, B, Zn, and Mo.

(175) Plass, William T.

1973. **Revegetating surface mined land.** Coal Min. & Process. 10(7): 54–55.

Reliable methods for establishing a protective vegetative cover have been developed in the Midwest and Appalachian regions. This can be achieved in the western states by utilizing existing knowledge, and conducting a diversified research and development program. It is appropriate to reflect briefly on current and future revegetation practices.

(176) Plass, William T., and Willis G. Vogel.

1973. **Chemical properties and particle-size distribution of 39 surface-mine spoils in southern West Virginia.** USDA Forest Serv. Res. Pap. NE-276. 8 p., illus.

A survey of 39 surface-mine sites in southern West Virginia showed that most of the spoils from current mining operations had a pH of 5.0 or higher. Soil-size material averaged 37 percent of the weight of the spoils sampled. A major problem for the establishment of vegetation was a deficiency of nitrogen and phosphorus. This can be corrected with additions of fertilizer at appropriate rates.

(177) Pogge, Franz L.

1973. **Greenbriers—great for wildlife.** Pa. Game News 44(7) : 29–31, illus.

Greenbriers rank among the best woody plants as food and/or cover for wildlife. Characteristics of the five greenbrier species that grow in Pennsylvania are described. The two species that are best for wildlife, common and cat greenbrier, can be propagated from seed or cuttings. Cuttings from "roots" (rhizomes or tubers) collected in the spring are recommended for small-scale propagation.

(178) Rammrath, Rita M.

1973. **Some predictions about natural Christmas trees.** S. Lumberman 226 (2801) : 15–16.

Through research, the Christmas trees of tomorrow may be better than the trees of today. Improved trees are being developed through selection and hybridization. Cultural practices are being developed to produce plantation-grown trees of better shape and color that may be able to compete more effectively with artificial trees.

(179) Rammrath, Rita M.

1973. **This researcher talks turkey.** Forest Farmer 32(4) : 8, illus.

To find out what forest conditions will support an abundance of wild turkeys, wildlife biologist William Healy "mothered" turkey broods for the first 4 to 5 days after hatching, which made them tame enough for handling and habitat studies.

(180) Rammrath, Rita M., and Walter R. Gooley, Jr.

1973. **So distinguished a forest! Only in Maine.** Maine Forest. Dep. and USDA Forest Serv. NE. Forest Exp. Sta. 28 p., illus.

A booklet extolling the forest resources of Maine. Based partly on results of the USDA Forest Service's forest survey of Maine.

(181) Rast, Everette D., David L. Sonderman, and Glenn L. Gammon.

1973. **A guide to hardwood log grading (Revised).** USDA Forest Serv. Gen. Tech. Rep. NE-1. 32 p., illus.

A revision of a handbook (by M. D. Ostrander and others) developed as a teaching aid and field reference in grading hardwood logs. Outlines basic principles and gives detailed practical applications, with illustrations, in grading logs and cruising timber. Includes standards for various use classes.

(182) Redman, John C., and Vincent Cusumano.

1973. **Monetary conditions and the U.S. lumber and wood products industry.** Univ. Ky. Agric. Exp. Sta. Res. Rep. 15. 30 p., illus.

The U.S. lumber and wood products industry is highly sensitive to changes in money market conditions. Employing ordinary least squares and regressing the respective lumber industry economic indicator on a monetary policy proxy, i.e., interest rates on new issues of 3-month treasury bills, the authors found that an inverse relationship exists between activities in this industry and monetary conditions. The extent of the industry response was calculated and the nature of its cyclical movements was described.

(183) Reinhart, Kenneth G.

1973. **Critique: forest fertilization impacts on water and the environment.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3 : 242–246.

Forest fertilization can contribute in many ways to an improved environment. It can help restore denuded or overused areas, improve wildlife habitat, release forest land for nonproduct uses, and help to recycle waste products. Yet forest fertilization could have a negative impact on the environment. The problem most likely to be encountered is an increase in the N level in streams and lakes, possibly leading to eutrophication.

(184) Reinhart, K. G.

1973. **Timber-harvest clearcutting and nutrients in the northeastern United States.** USDA Forest Serv. Res. Note NE-170. 5 p.

The effect of ecosystem disturbance on nutrients in the system has been receiving widespread attention. An appraisal of research results in the Northeast indicates that timber-harvest clearcutting has not increased nutrient levels sufficiently to reduce water quality below drinking water standards.

Losses of nutrients from clearcuttings in New Hampshire over a 2-year period were about 85 pounds per acre for nitrate-N and 80 pounds per acre for Ca. Losses in the central and southern Appalachians were far less. There is both need and opportunity for productive research on many aspects of nutrient flow in forested ecosystems.

(185) Rennie, Peter J.

1973. **Critique: Forest fertilization—retrospect and prospect.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 234–241.

This symposium brought together solid contributions on numerous nutritional and environmental aspects of forest fertilization in the Northeast, a region characterized by high utilization and population pressures. We seek a reliable, economic, and environmentally safe technology. The 22 papers include economic and human relationships, production for fiber and other purposes, methodology, a bridging of the traditional and newer aspects of forest fertilization, and environmental effects. Considering the positive research results that have been achieved, there has been surprisingly little commercial application. We need more cooperation in future research.

(186) Rexrode, Charles O., and Robert E. Frame.

1973. **The effect of two oak wilt control methods on oak bark beetle populations, mat production, and disease incidence.** USDA Plant Dis. Rep. 57(12): 1055–1058.

In West Virginia, 2323 oaks infected with the oak wilt fungus were girdled, felled, or left untreated. Effects of these treatments on oak bark beetle attacks, fungus mat production, and disease incidence were determined. Density of beetle attacks and fungus mats were lowest on the felled trees. The incidence of oak wilt declined as the density of beetle attacks dropped.

(187) Richards, Norman A., and Raymond E. Leonard.

1973. **Urban forestry and recreation developments in relation to fertilization.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 111–116.

Urban and recreational forest areas present complex problems because of heavy use pressures, but their higher values increase the feasibility of intensive management inputs such as fertilization wherever benefits can be shown. Situations in which fertilization is potentially useful are explored, including sites recently developed on stripped soils or poor land, rehabilitation of sites deteriorated by overuse, treatment of vegetation damaged by direct or indirect people pressure, and treatments to counteract eutrophication effects on heavily-used sites.

(188) Roach, B. A.

1973. **Clearcutting in hardwoods.** Va. Forests 27(4): 7–11, 16, illus.

Clearcutting is under attack by conservation groups who confound it with the exploitative logging operations of the past. This paper shows that clearcutting, when properly applied, is necessary to reproduce new forests under certain conditions. The real issues are: what area will be clearcut at one time; how will these areas be distributed; what percentage of the forest will be in this condition at any one time, and for how long?

(189) Romberger, J. A., and C. A. Tabor.

1973. **Accumulation of externally polymerized polysaccharide beneath *Picea abies* shoot apical domes in culture.** (Abstr.) Am. J. Bot. 60(Suppl.): 13.

Apical shoot domes of cultured *Picea abies*, supported on a 25 μm mixed esters of cellulose (MEC) membrane deposit polymerized polysaccharide on the membrane. The nature of the deposit and the origin of its precursors in the cultured dome are supported by microspectrophotometric, microchemical and gravimetrical evidence. Polysaccharide accumulation begins within 24 hours of explanting and will appear on a membrane underneath the first within the same 24 hour period.

(190) Rushmore, Francis M.

1973. **Techniques for calling sapsuckers and finding their nesting territories.** USDA Forest Serv. Res. Pap. NE-281. 7 p.

In 9 years of study in Maine, the author developed a survey method for estimating populations of yellow-bellied sapsuckers (*Sphyr-*

apicus varius varius L.) and delineating their territories. The birds were attracted for study by tapping hardwood dowels to imitate noises the birds make in drumming and feeding.

(191) Safford, L. O.

1973. **Fertilization increases diameter growth of birch-beech-maple trees in New Hampshire.** USDA Forest Serv. Res. Note NE-182. 4 p.

In a 60-year-old northern hardwood stand treated with lime plus NPK fertilizer, the following increases in average basal area growth rate over untreated trees were observed: sugar maple 128 percent, paper birch 69 percent, yellow birch 51 percent, and beech 20 percent. Magnitude of response was inversely related to relative growth rate of the species. Growth rate before treatment was used as a covariate to adjust treatment means for differences in vigor of the trees.

(192) Safford, L. O.

1973. **Forest fertilization in the eastern United States: conifers.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 206–210.

Past and current forest-fertilization experiments have demonstrated that northeastern conifers respond favorably to nutrient supplements when deficiency conditions exist. No universal combination of nutrients or application rate has given response in all situations. Applications of fertilizer to forests are advocated only as a part of intensive silvicultural practice in situations where silvicultural and management objectives are well defined.

(193) Sanderson, H. Reed, and Larry A. Berry.

1973. **Gray squirrels reproduce in a 2-acre enclosure.** USDA Forest Serv. Res. Note NE-174. 6 p., illus.

A 2-acre enclosure was built in a 40-year-old hardwood stand, and 5 to 19 gray squirrels (*Sciurus carolinensis*) were confined in it during 3 years. Reproductive behavior of the squirrels was the same at all population densities, but densities above 12 may have reduced productivity. For 10 to 12 squirrels, behavior was about normal and productivity was high. At population levels above 12, antagonistic behavior and fence-running increased. The enclosure was modified until escapes were reduced to less than 10 percent per year. Disease and predation were not a problem. Fence costs were $2,000 for materials and about 125 man-days of labor. The enclosure proved practical for squirrel research.

(194) Sanderson, H. Reed, and Larry A. Berry.

1972. **A 2-acre enclosure for tree squirrel research.** 26th Annu. Conf. Southeast. Assoc. Game Fish Comm. 1972 Proc. p. 298–300, illus.

A 2-acre enclosure for gray squirrels (*Sciurus carolinensis*) was built and tested. At the optimum density of 10 to 12 squirrels, reproduction was not inhibited by the enclosure and all litters survived. The enclosure design is suitable for many kinds of research on tree squirrels.

(195) Sarles, Raymond L.

1973. **Bark—a Cinderella story.** N. Logger 21(9): 14–15, 36, illus.

Until recently, bark has been the most difficult wood processing residue to convert into usable, marketable products. But now bark producers are effectively entering the markets for mulches and soil conditioners. This article describes these markets and the ways in which bark is used effectively for mulches and soil amendments. The article should provide a stimulus to interest wood processors in exploiting these new bark markets.

(196) Sarles, Raymond L.

1973. **Using and marketing bark residues.** Forest Prod. J. 23(8): 10–14, illus.

Increasing amounts of bark residue are being used in the United States for two reasons: enforcement of antipollution regulations and the development of new ways to process bark and market bark products. Both coniferous and hardwood tree barks are processed in large volume for several types and grades of mulches and soil conditioners, and the market is apparently growing. Unprocessed bark residues are used for various purposes in agriculture, industry, and construction, and these uses are growing. The variety of ways in which bark residues are now used suggests

a host of opportunities for wood processors seeking answers to bark disposal problems.

(197) Schreiner, E. J.
1972. **Genetic improvement of amenity trees.** Trees 32(6):112–114.
The author points out the possibilities of improving amenity trees. Racial and individual variation, vegetative propagation, dangers of monoculture, clonal testing for growth, pest and pollutant resistance, and species offering improvement possibilities are discussed.

(198) Schreiner, Ernest J.
1973. **Some aspects of NEFTIC in retrospect and prospect.** NE. Forest Tree Improve. Conf. Proc. 20:28–32.
A review of the Northeastern Forest Tree Improvement Conference from its inception in 1953 to the present. Of particular concern are the problems of the various technical committees and suggestions for organizing future committees. The problem of programing meetings to interest both research and practicing foresters is discussed along with industry interest and support of tree improvement programs. Finally, future prospects for the organization and genetic improvement of northeastern forest tree species are discussed.

(199) Schrepfer, Susan R., Edwin vH. Larson, and Elwood R. Maunder.
1973. **A history of the Northeastern Forest Experiment Station, 1923 to 1973.** USDA Forest Serv. Gen. Tech. Rep. NE-7. 52 p., illus.
A 50-year summary of federal forestry research in the Northeast, tracing the establishment and development of the original Northeastern Station at Amherst, Mass., and the Allegheny Station at Philadelphia, Pa., and their merger into the present Northeastern Station. Highlights of research programs, trends, and accomplishments.

(200) Scott, Eion G., and Bearce, Bradford C.
1973. **Production of Cara Mia roses in various loamless composts.** Florists Rev., June 1973: 27, 59–61, illus.
Because of the problems in disposing of bark fines (screenings) generated in bark mulch production, mixtures of bark fines and sawdust were compared with peat-vermiculite mixes as growing media for Cara Mia roses, a long-term greenhouse crop. The productivity of all media decreased with age, and all media fortified with slow-release fertilizer produced more flowers than media fertilized with standard fertilizer. Overall results indicate that bark-sawdust mixtures can be used as alternatives to peat-vermiculite for growing greenhouse roses.

(201) Seegrist, Donald W.
1973. **Least squares analysis of experimental design models by augmenting the data with side conditions.** Technometrics 15(3): 643–645.
One method of analyzing an experimental design model is to impose side conditions on the observational equations and then to solve the "reduced" model by least squares. The author demonstrates another method, which is not widely known: augment the data with the side conditions and then solve the augmented model by least squares.

(202) Seliskar, Carl E.
1973. **Association of a mycoplasmalike organism with walnut bunch disease.** 2nd Int. Congr. Plant Pathol. U. Minn. Minneapolis. Abstr. 0933.
An electron microscope investigation of the phloem tissues of Japanese walnut, *Juglans sieboldiana*, revealed a mycoplasmalike organism (MLO) in diseased but not in healthy leaf, stem, and root phloem cells. The MLO are plemorphic, vary in length from 150 to 1000 nm, and are enclosed in a plastic trilaminar unit membrane. Spherical or oval shapes predominate, but tubular forms were also evident near sieve plates. Binary fission was suggested by the appearance of forms with centralized constrictions. Some sections clearly showed ribosome- and DNA-like material within MLO cells.

(203) Seliskar, Carl E.
1973. **Book review of "A textbook of plant virus diseases."** Forest Sci. 19: 189–190.
This classical text has become the standard reference on plant virus disease throughout the world, ever since the first edition appeared in 1937. The new third edition contains information on more virus diseases in a

single volume than any other reference book in print. Many new illustrations, including numerous micrographs of viruses, are presented. Yellows-type diseases, formerly thought to be virus-caused, are excluded because of the recent discovery of mycoplasmas in association with such diseases. While the coverage of forest tree virus diseases is good, it is not nearly as comprehensive as the coverage of other plant viruses.

(204) Seliskar, Carl E., Charles L. Wilson, and Carol E. Bourne.
1973. **Mycoplasmalike bodies found in phloem of black locust affected with witches'-broom.** Phytopathology 63(1): 30–34, illus.

Pleomorphic bodies resembling mycoplasmas were found in the phloem tissues of black locust trees (*Robinia pseudoacacia*) affected with witches'-broom. These bodies ranged in size from 90 to 1,000 nm. They contained ribosomelike bodies and strands typical of mycoplasma DNA. They were delimited by a trilaminar membrane. No mycoplasmalike bodies were observed in the phloem tissues of healthy black locust.

(205) Sendak, Paul E.
1973. **Wood pallet manufacturing costs in Pennsylvania.** Forest Prod. J. 23(9): 110–113, illus.

A study was made of wood pallet manufacturing costs in a small group of pallet plants in Pennsylvania. The cost data are used to estimate the long-run average cost curve for wood pallet production and to define the optimum-size production plant. The amount of efficient industrial capacity is assessed, and the reasons for the existence of inefficient capacity are discussed.

(206) Shafer, Elwood L., Jr., and Douglas A. Morrison.
1973. **Changing attitudes among forestry students.** J. Environ. Educ. 4(4): 44–47.

A silent revolution may be going on in the forestry profession, according to a recent survey of forestry students. One of the challenges facing the forestry profession today is how to meet the increasing demand for wildland recreation activities such as hiking, canoeing, and mountain climbing and also the demand for scenic beauty in forests that are managed for both timber and recreation.

(207) Shafer, Elwood L., and Michael Tooby.
1973. **Landscape preferences: an international replication.** J. Leisure Res. 5(3): 60–65, illus.

A landscape preference study, originally conducted in the United States, was replicated in Scotland. Ranked preference values for black and white photographs of natural landscapes were very similar for the two studies. Therefore the landscape preference equation, developed from data in the initial study, would have predicted quite accurately the landscape preferences of people in Scotland. Study results strengthen the predictability and versatility of the initial equation.

(208) Sharon, Edward M.
1973. **Some histological features of *Acer saccharum* wood formed after wounding.** Can. J. Forest Res. 3: 83–89, illus.

A technical paper that supports a concept of compartmentalization of defects within living trees. A pattern is demonstrated of chemical and morphological changes occurring in maple wood that forms after wounding and that result in a distinct tissue. A protective role is suggested for the tissue.

(209) Shigo, Alex L.
1973. **Biology of decay and wood quality.** 2nd Int. Congr. Plant Pathol. U. Minn. Minneapolis. Abstr. 0565.

Decay is the final stage of a long and complicated process that is initiated by wounds and involves chemical and anatomical protective responses of the tree and interactions of micoorganisms among themselves and with the tree. A model of the decay process has been developed, based on the events that are known to occur from time of wounding to total decomposition of wood. The model is divided into three major stages: (1) host response to wounding; (2) invasion by pioneer microorganisms; and (3) decay of dead cells.

(210) Shigo, Alex L.
1973. **Insect and disease control: forest fertilization relations.** *In* Forest Fert. Symp. Proc. USDA Tech. Rep. NE-3: 117–121.

Insect and disease control in the past emphasized reduction of damage to trees grown for wood products. Now control measures must include reduction of damage to trees in scenic areas, recreation sites, watersheds, and rural areas. Fertilizers are being considered for control, in combination with other materials. Some effects of fertilizers on insects and diseases are discussed.

(211) Shigo, Alex L., and W. E. Hillis.
1973. **Heartwood, discolored wood, and microorganisms in living trees.** Annu. Rev. Phytopathol. 11: 197–222.

The main visible change observed in wood of trees is change of color. This can be the result of processes associated with aging (heartwood), injury (discolored wood), or both. However there are more important characteristics than color for the sapwood altered by these processes. The factors that initiate the formation of heartwood, discolored wood, and extractives (which are largely responsible for color) are different. This is the major reason for the confusion in understanding a situation when color alone is the basis for distinguishing the type of tissue under study. This review discusses those processes in living trees that are associated with colored wood, in the hope of clarifying them so that future research will be more accurately oriented and the opportunity to bring these changes under our control will be improved.

(212) Shigo, Alex L., William B. Leak, and Stanley M. Filip.
1973. **Sugar-maple borer injury in four hardwood stands in New Hampshire.** Can J. For. Res. 3(4) :512–515, illus.

Forty-three percent of 348 sugar-maple trees, *Acer saccharum* Marsh., in 60 plots, in four hardwood stands were injured by the sugar-maple borer, *Glycobium speciosus* (Say). The percentage of injured trees was greater in uneven-aged stands than in even-aged stands. The microorganisms isolated from discolored and decayed wood associated with borer injuries were the same as those isolated from discolored and decayed wood associated with wounds on sugar maple.

(213) Shortle, Walter C., and Alex L. Shigo.
1973. **Concentrations of manganese and microorganisms in discolored and decayed wood in sugar maple.** Can. J. Forest Res. 3(3) : 354–358, illus.

Columns of discolored and decayed wood associated with 8-year-old wounds and contiguous clear wood in five sugar maple trees, *Acer saccharum* Marsh., were mapped systematically for microorganisms and concentrations of manganese. The concentrations of manganese were higher in those tissues at the interface between discolored wood and decayed wood that frequently yielded Hymenomycetes in culture, than in contiguous clear tissues. Changes in ash, moisture, and pH may be more related to the tree response to wounding, while manganese concentrations may be more related to the concentration and species of microorganisms in the tissues.

(214) Smith, H. Clay, and Albert G. Snow, Jr.
1973. **La mise en place d'une tuyauterie de plastique pour la cueillette de la sève d'érable.** (French translation of Research Paper NE-240) 16 p., illus. William T. H. Nicholson, Lake Catherine, St. Emile de Montcalm, Quebec, Canada.

A reprinting, in French, of USDA Forest Service Research Paper NE-240 (1972), describing methods and equipment for using plastic tubing to collect sugar maple sap.

(215) Smith, H. Clay, and Russell S. Walters.
1971. **Aerial line or ground line?** Natl. Maple Syrup Dig. 10(4) : 10, 11, illus.

Two methods of using plastic tubing to collect sugar maple sap were tried: aerial lines and ground lines. Unvented spouts were used in both. No difference was found in the amount of sap collected when an unvented aerial tubing line was compared to an unvented line on the ground. However, the aerial line is recommended over the ground line where snow may be encountered because the aerial line is easier to maintain.

(216) Sopper, William E., and Louis T. Kardos (eds.).
1973. **Recycling treated municipal waste-**

water and sludge through forest and cropland. Pa. State Univ. Press, University Park, Pa. 479 p.

Proceedings of a symposium conducted by the College of Agriculture and the Institute for Research on Land and Water Resources, Pennsylvania State University, in cooperation with the Pinchot Institute of the Northeastern Forest Experiment Station, USDA Forest Service, and the Office of Research and Monitoring, Environmental Protection Agency. Contains 32 papers.

(217) Sopper, W. E., and L. T. Kardos.
1973. **Vegetation responses to irrigation with treated municipal wastewater.** *In* Recycling treated municipal wastewater and sludge through forest and cropland. Pa. State Univ. Press, University Park, Pa. p. 271–294.

Mineral-enriched effluents can disrupt aquatic environments and even produce problems in land applications. An application of 2 inches a week during six growing seasons decreased the growth of red pines after the first 2 years, whereas treatments of either 1 or 2 inches per week greatly increased the growth of white spruce and hardwoods. Corn crops take up annually more nutrients (N, P, K, Ca, Mg) than does a hardwood forest, but during the winter forests provide better infiltration conditions than cropland. A combination of cropland and forestland will provide the greatest flexibility in year-round application of sewage effluent to land.

(218) Spomer, L. Arthur.
1973. **Construction of welded "wet-loop" thermocouple psychrometer junctions.** Agron. J. 65(3) : 60–61, illus.

The thermocouple psychrometer technique is indispensable for the study of plant and soil-water relationships. Because available thermocouple loop junctions were difficult to construct and were subject to incomplete junction-wetting error, a new type welded-loop junction was constructed and evaluated. The new loop is easily constructed of commercially available materials, and it proved to be more sensitive and/or more stable than other types of junctions.

(219) Spomer, L. Arthur.
1973. **Soils in plant containers: soil amendment, air, and water relationships.** Ill. Res. 15(3) : 16–17, illus.

Maintaining the proper soil-water-air matrix is an important problem in successfully growing plants in containers. The ideal container "soil" is one that has enough small pores to provide adequate water storage and enough large pores to provide aeration: this can be approximated by mixing the "critical proportion" of coarse-textured amendment (sand, vermiculite, peat, sawdust, bark, etc.) with soil or another amendment. With the wide range of available containers and amendments, it is possible to develop a suitable container-"soil" combination for any ornamental plant.

(220) Stern, E. G.
1973. **Douglas-fir lumber pallets assembled with stiff-wood and hardened-steel pallet nails.** VPI & State Univ., Wood Res. & Wood Construct. Lab. Bull. 120. 12 p., illus.

The feasibility of upgrading dry Douglas-fir lumber pallets through use of hardened-steel nails was tested in this study. Test results indicated that pallet rigidity was, on the average, increased 60 percent if helically threaded, hardened-steel pallet nails were used instead of similar stiff-stock nails. This finding was in agreement with previous results on other species.

(221) Stern, E. G.
1973. **Reconfirmation of MIBANT test criteria for pallet nails.** VPI & State Univ., Wood Res. & Wood Construct. Lab. Bull. 122. 11 p., illus.

Test criteria for pallet nails, tentatively accepted by the National Wooden Pallet and Container Association in 1973, were based on the MIBANT device for testing nails for their toughness and lack of brittleness. It was agreed that these test criteria should be subject to review for one year before full acceptance. They have now been accepted as the official standard by the NWPCA.

(222) Stone, Earl L.
1973. **Regional objectives in forest fertilization: current and potential.** *In* Forest

Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 10–18, illus.

A region defined by a 1,500-km. diameter circle around Warrensburg, N.Y., contains a variety of climates, vegetation types, and economies and one-fourth to one-third of the total population of North America north of Mexico. The vast and varied impacts of this great population impose an increasing concern with uses and values of forest land. Nine regional objectives for use of this land are discussed.

(223) Striffler, David W.

1973. **Surface mining disturbance and water quality in eastern Kentucky.** *In* Ecology and reclamation of devastated land. Russell J. Hutnik and Grant Davis (eds.). Vol. I: 175–190, illus. Gordon & Breach, New York.

Surface mining for coal has disturbed thousands of acres in eastern Kentucky. A streamwater-quality survey was conducted in 1966; stream discharge, water temperature, dissolved oxygen, pH, EH, specific conductance, and the concentrations of six ions were measured. Very little acid pollution was found in major streams, but pollution of some small streams was severe.

(224) Swett, Charles E.

1973. **An inexpensive mist system for plant propagation.** Tree Planters' Notes 24(2): 4–5.

A reliable greenhouse mist system has been devised at the Forest Service's Northeastern Forest Experiment Station, using inexpensive materials that can be easily obtained.

(225) Talerico, Robert L., and Thomas A. Skratt.

1973. **An application of a microvideo system to entomology.** J. Econ. Entomol. 66(3): 816–817, illus.

This note describes the use of a microvideo system (television camera, monitor and special lens) to aid in counting the number of elm spanworm eggs in a mass. Results are compared to a conventional binocular dissecting microscope system.

(226) Talerico, Robert L., and Robert W. Wilson, Jr.

1973. **Sampling plantations to determine white-pine weevil injury.** USDA Forest Serv. Res. Note NE-173. 4 p., illus.

Use of 1/10-acre square plots to obtain estimates of the proportion of never-weeviled trees necessary for evaluating and scheduling white-pine weevil control is described. The optimum number of trees to observe per plot is estimated from data obtained from sample plantations in the Northeast and a table is given of sample size required to achieve a standard error of the proportion of trees never weeviled of $\pm$ 0.05, a value that can be obtained at a reasonable cost for the purpose intended.

(227) Thomas, Jack Ward, Robert O. Brush, and Richard M. DeGraaf.

1973. **Invite wildlife to your backyard.** Natl. Wildl. 11(3): 5–16, illus.

A comprehensive plan for developing a backyard to attract wildlife. Steps and stages are described in the development of a balanced environment to provide food, cover, water, and reproductive areas. Trees and shrubs suitable for accomplishing this are listed.

(228) Thomas, Jack Ward, and Richard M. DeGraaf.

1973. **Non-game wildlife research in megalopolis: the Forest Service Program.** USDA Forest Serv. Gen. Tech. Rep. NE-4. 12 p.

The management of city habitats for wildlife production for enjoyment in forms other than hunting will require extensive coordinated research to provide guidance for such efforts. A generalized framework for such research is suggested and thirteen research studies particularly suited to the Forest Service research unit at Amherst, Mass., are outlined.

(229) Thomas, Jack Ward, and Ronald A. Dixon.

1973. **Cemetery ecology.** Nat. Hist. 82(3): 60–67, illus.

In a study of cemeteries in the Greater Boston area, the authors found a surprisingly great variety of wildlife. As urbanization continues, cemeteries will be among the few available areas that could relieve the pressure for open space, provide some wildlife habitat, and improve the quality of human environment in our cities.

(230) Thomas, Jack Ward and Ronald A. Dixon.

1973. **Cemetery ecology.** Catholic Cemetery 13(10): 20–25.

Reprinted from Natural History.

(231) Thomas, Jack Ward, Rodney G. Marburger, and Calvin Van Hoozer.

1973. **Rio Grande turkey migrations as related to harvest regulation in Texas.** *In* Wild Turkey Management: 301–308, illus. Univ. Mo. Press, Columbia.

Turkeys on the Edwards Plateau made annual migrations averaging 10.9 air miles for 53 records from 310 marked birds. Turkeys marked in wintering areas always returned. Land is in private ownership and hunting rigidly controlled. Fall seasons occur with turkeys in wintering areas and underharvest results. Harvest might be increased by (1) spring gobbler hunting when turkeys are dispersed and (2) making hens legal game during existing fall seasons.

(232) Thomas, Jack Ward, James C. Pack, John D. Gill, and R. Wayne Bailey.

1973. **Even-age management, turkeys and turkey hunters—a new study.** *In* Wild Turkey Management: 273–276. Univ. Mo. Press, Columbia.

Methods for coordinating even-aged hardwood management and turkey-habitat management are being studied in West Virginia on a 20,000-acre study area. Effects of timber-cutting treatments on turkeys, deer, squirrels, and grouse, and on hunter attitudes and behavior, are to be determined. Some 1,200 to 1,400 hunters are interviewed annually.

(233) Thomas, Jack Ward, James C. Pack, William M. Healy, John D. Gill, and H. Reed Sanderson.

1973. **Territoriality among hunters—the policy implications.** Trans. 38th N. Am. Wildl. Nat. Resour. Conf. p. 274–280.

Management of public forest land requires communication between the manager and the people who are most interested in specific land units. On a 20,000 acre tract, 30 percent of the hunters hunted the same location more than once. These home-range hunters saw and killed more game and presumably had a more territorial (defensive) interest in their hunting locations than transient hunters did. But few of these hunters would attend local planning meetings because distances between their hunting locations and residences averaged 110 miles. We recommend special efforts to identify and communicate with home-range hunters.

(234) Trimble, G. R., Jr.

1973. **Appalachian mixed hardwoods.** *In* Silvicultural systems for the major forest types of the United States. USDA Agric. Handb. 445, p. 80–82.

The location, composition, and characteristic soil types of Appalachian hardwoods are described. The advantages and disadvantages of different silvicultural systems are discussed in the context of the conditions in which stands occur. In general the seed tree method is not recommended. Clearcutting has distinct advantages if high value light-demanding species predominate, and if short-term undesirable asthetic impacts are not a major concern.

(235) Trimble, G. R., Jr.

1973. **Response to crop-tree release by 7-year-old stems of yellow-poplar and black cherry.** USDA Forest Serv. Res. Pap. NE-253. 10 p., illus.

Five years after crop-tree release of yellow-poplar and black cherry stems in a 7-year-old stand of Appalachian hardwoods, measurements indicated that released trees were but slightly superior to control trees in height, diameter, and crown position. Sprout regrowth of cut tree stems and grapevines had largely nullified the effects of release. Indications are that for release to be effective, crop trees of these species on good sites should be 15 to 20 feet tall.

(236) Trimble, G. R., and C. E. McGee.

1973. **Natural regeneration of central Appalachian hardwoods in West Virginia.** First Annu. Hardwood Symp. Proc.: 45–53. Hardwood Res. Counc., Statesville, N.C.

This paper reports on results from regeneration studies made mostly in West Virginia. It discusses the relationships found among hardwood regeneration and such variables as site quality and cutting practice. Special em-

phasis is placed on the effect of cutting practice on species composition.

(237) Trimble, G. R., Jr.
1973. **The regeneration of central Appalachian hardwoods with emphasis on the effects of site quality and harvesting practice.** USDA Forest Serv. Res. Pap. NE-282. 14 p.
This report integrates and summarizes research results from studies made mostly in West Virginia. It discusses the relationships found among the nature of hardwood regeneration, site quality, and cutting practice, with special emphasis on species composition.

(238) Trimble, George R., and Donald W. Seegrist.
1973. **Epicormic branching on hardwood trees bordering forest openings.** USDA Forest Serv. Res. Pap. NE-261. 6 p.
Epicormic branching in hardwoods can degrade logs and reduce the dollar returns from growing trees. A study made around clearcut openings of various sizes showed that the following variables were related to the degree of epicormic branching on trees bordering the openings: size of opening, species, tree dominance class, exposure of tree bole, and position on tree bole.

(239) U.S. Forest Service.
1973. **Enjoy your fireplace, especially during the energy crisis.** NE. Forest Exp. Sta. and NE. Area State and Private Forestry. 7 p.
Advice on where to get firewood, the kinds of wood best for burning in a fireplace, and how to build a fire. Density and heat value are tabulated for 33 tree species. Safety is emphasized.

(240) U.S. Forest Service.
1973. **Trees for polluted air.** USDA Misc. Publ. 1230. 12 p., illus.
A leaflet describing how air pollution injures trees. Tree species are tabulated according to their known degree of sensitivity to the common air pollutants. Based on an earlier leaflet, "Our air: unfit for trees," published in 1972 by the Northeastern Forest Experiment Station.

(241) U.S. Forest Service.
1973. **Wounded trees mar our environment.** NE. Forest Exp. Sta. and NE. Area State and Private Forestry. 13 p., illus.
A brochure describing different types of wounds on trees and suggesting how to care for trees to avoid wounding and how to treat wounded trees. Based on research by pathologist Alex L. Shigo; illustrations by David M. Carroll.

(242) Vogel, Willis G.
1973. **The effect of herbaceous vegetation on survival and growth of trees planted on coal-mine spoils.** Natl. Coal Assoc. Res. and Appl. Tech. Symp. on Mined-Land Reclam.: 197–207, illus.
Establishing both trees and herbaceous vegetation is often desirable in the reclamation of strip-mine spoil banks. To study the effect of herbaceous competition with trees, grass alone and grass with legumes were sown concurrently with the planting of four tree species on coal-mine spoils in southeastern Kentucky. After three growing seasons, the herbaceous vegetation, which had produced about 95 percent ground cover, did not significantly affect the survival of trees, but greatly suppressed their growth. However, in the fourth and fifth growing seasons, the growth of trees in the plots dominated by the legumes exceeded the growth in plots with grass only and without herbaceous competition. Tree growth was suppressed the most by a cover of grass alone.

(243) Vogel, Willis G., and William A. Berg.
1973. **Fertilizer and herbaceous cover influence establishment of direct-seeded black locust on coal-mine spoils.** *In* Ecology and reclamation of devastated land. Russell J. Hutnik and Grant Davis (eds.) Vol. II: 189–198. Gordon & Breach, New York.
After one growing season, black locust (*Robinia pseudoacacia* L.) seeded on plots fertilized with P averaged three to four times taller than those seeded on unfertilized plots. Adding N with P produced even greater growth. When fertilized, seeded herbaceous vegetation competed with seeded black locust. Competition was especially severe with species that make dense and rapid growth

early in spring. Competition was less severe when black locust was seeded with slower developing herbaceous species, or with species that grow in late spring and summer.

(244) Wallin, W. B.
1973. **Required pallet research: economic aspects.** Proc. Opportunities for Virginia's pallet industry. VPI & State Univ., Blacksburg, Va. p. 32–38.
The trend toward a national pallet exchange system during the past decade has fostered a series of new marketing problems. Interchange of pallets among thousands of users, each of whom may procure pallets from different suppliers in different parts of the country, requires that common standards be employed to insure that all exchange pallets are of relatively equal value when produced from all combinations of raw materials. The efficient use of available raw materials requires standard grades and standard construction methods. The initiative must come from the users, and the technical standards must be provided by the producers. Systematic progressive research studies are requisite to adoption of standards.

(245) Walton, Gerald S., and C. J. DeMars.
1973. **Empirical methods in the evaluation of estimators.** USDA Forest Serv. Res. Pap. NE-272. 15 p.
The authors discuss the problem of selecting estimators of density and survival by making use of data on a forest-defoliating larva, the spruce budworm. Various estimators are compared. The results show that, among the estimators considered, ratio-type estimators are superior in terms of bias and variance. The methods used in making comparisons, particularly simulation, are generally applicable to situations in which data appropriate for making estimates are on hand.

(246) Wargo, P. M. and D. R. Houston.
1973. **Infection of defoliated sugar maple trees by** *Armillaria mellea*. Phytopathology 63(2): 209.
The attack on defoliated trees by *Armillaria mellea* may be influenced by time of season and frequency of defoliation. Sugar maple trees (*Acer saccharum*) defoliated by the saddled prominent, *Heterocampa guttivitta*, and artificially defoliated trees were inoculated with *A. mellea* to determine the relationship of these factors to infection by the fungus. Insect populations collapsed, and resulted in a low incidence of infection and mortality of trees by *A. mellea*. Not all dead trees were infected by *A. mellea*, and observations indicated that *Stegonosporium ovatum* may be involved in the death of severely stressed tissues.

(247) Weetman, Gordon F., and Stuart B. Hill.
1973. **General environmental and biological concerns in relation to forest fertilization.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 19–35.
Forest fertilization, unlike agricultural fertilization, adds nutrients to relatively stable natural ecosystems in which there is an annual recycling of nutrients through humus decomposition. Not only can the new nutrient additions have direct effects on tree and other plant growth; but because the primary productivity is changed, all the consumers and decomposers in the ecosystem can also be modified. The authors outline the probable magnitude and direction of these changes.

(248) Werner, Robert G.
1973. **Water quality—limnological concerns about forest fertilization.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 72–78.
From the viewpoint of a limnologist, the author discusses possible effects of forest fertilization on the aquatic ecosystems of streams and lakes and raises a number of questions for consideration. Since forest fertilization is still in its infancy, we should begin an intensive search for answers to these questions, hoping that the fears of limnologists may be unfounded.

(249) West Virginia Department of Natural Resources.
1973. **The primary forest industry of West Virginia—1973.** W. Va. Dep. of Nat. Resour. Bull. 72 p., illus.
West Virginia's primary forest industry is an important part of the state's rural economy. Sawmills and planing mills alone comprised 354 firms, employed 4,200 people, and had an

annual payroll of more than $16.7 million. Value added in manufacture by these firms increased more than 50 percent to over $32 million from 1963 to 1967. In addition, over 100 other primary wood products firms were in operation. The market operations of many of these firms are hampered by their predominantly rural location and by the exclusion of most wood producers from the State's industrial directory. A separately published directory of these firms listing their raw material needs, productive capacity, and product offering contributes substantially to the overall success of their market operations.

(250) Wiackowski, S. K., and L. S. Dochinger.

1973. **Interactions between air pollution and insect pests in Poland.** 2nd Int. Congr. Plant Pathol. U. Minn. Minneapolis Abstr. 0736.

Major problems in forest protection occur in Upper Silesia, Poland's industrial center, where a million tons of particulates and 200 billion m^3 of polluted gases are emitted yearly into the atmosphere. Insect exploitation of pollution-stressed forest stands may be prevented through sanitation measures, biological control, selection and breeding of tolerant trees, and land-use planning of forest resources.

(251) Wilkinson, Ronald C.

1973. **Inheritance and correlation of growth characters in hybrid poplar clones.** NE. Forest Tree Improv. Conf. Proc. 20: 121–130.

Genetic and phenotypic correlations and broad-sense heritabilities of total height and diameter at four ages were determined for hybrid poplars grown in a replicated clonal test for 15 growing seasons. Clonal variance components were large enough to permit effective selections for final rotations of 1, 4, 9, or 15 years. The amount of realized genetic gain would depend on selection age, clonal component of the test, and site. Selection for height or diameter after nine growing seasons would result in the greatest gains, whereas selection for 1-year height would be the least effective. Genetic correlations between 15-year heights and diameters and measurements made before nine growing seasons were generally positive but relatively low and quite variable from one plantation to another.

(252) Williams, George P., Jr.

1973. **Changed spoil dump shape increases stability on contour strip mines.** Nat. Coal Assoc. Res. and Appl. Tech. Symp. on Mined-Land Reclam.: 243–249, illus.

A survey of sites in eastern Kentucky mined under 1967 Kentucky regulations showed 178 landslides but 94 percent of the total bench was stable. Slide incidence and site steepness were not found to be related. A 42 percent reduction in area disturbed by landslides and a 17 percent reduction in total area disturbed by mining was attributable to the geometry of spoil dumps as called for in the 1967 regulations.

(253) Williamson, Robert D.

1973. **Bird- and people-neighborhoods.** Nat. Hist. 82(9): 55–57, illus.

This study measured the occurrence and distribution of songbirds in adjacent neighborhoods to Rock Creek Park in Washington, D.C., including the following songbird species —cardinals, mockingbirds, catbirds, wood thrushes, house sparrows, pigeons, starlings, robins, blue jays, and song sparrows. Birds were correlated with vegetation, socioeconomic and demographic variables. Results are compared between two distinctly different areas—the teeming east side, with multistory apartments and sparse vegetation, and the lush manicured vegetation of the west side.

(254) Wilson, C. L., and A. L. Shigo.

1973. **Dispelling myths in arboriculture today.** Am. Nurseryman 127: 24–28.

Some practices in arboriculture are based entirely or partly on myths rather than on scientific facts. This brief paper points out some myths about Dutch elm disease, cavity filling, tree wound dressings, and fertilization.

(255) Wolf, Charles H.

1973. **Employee turnover: costs, causes, and methods of control.** N. Logger & Timber Processor 22(1): 26–27, 40, 42–43, illus.

Employee turnover rates are much higher in sawmills than in other types of manufacturing. Quits, which comprise the majority of job terminations, occur most often among unskilled workers during their first month of employment. A list of the items considered in estimating turnover costs is given, along with a discussion of the major causes of turnover. Suggestions are made for controlling high turnover.

(256) Wolf, Charles H.
1973. **Predictors of job tenure in a lumber-plywood mill.** USDA Forest Serv. Res. Note NE-164. 4 p., illus.

Multiple discriminant analysis was used to identify biographic and employment history variables associated with job tenure in a lumber-plywood mill. Several variables—friends and relatives, type of housing, commuting distance, and prior work experience in the wood industry—were found to be significant.

(257) Yawney, H. W., and R. S. Walters.
1973. **Special forest crops and forest fertilization.** *In* Forest Fert. Symp. Proc. USDA Forest Serv. Gen. Tech. Rep. NE-3: 122–131, illus.

The general objectives of fertilization for special forest crops such as maple syrup and Christmas trees are much the same as for other forest products—to increase production and improve quality. Fertilization for increased syrup production is considered under the same soil considerations necessary for increased production of other forest crops. Short rotations and the high potential value of the crop make Christmas trees especially well suited to intensive cultural techniques such as fertilization.

(258) Yendol, William G., Ronald A. Hamlen, and Franklin B. Lewis.
1973. **Evaluation of *Bacillus thuringiensis* for gypsy moth suppression.** J. Econ. Entomol. 66(1) : 183–186, illus.

Field efficacy of commercial *Bt* formulations applied at 8 and 16 billion I.U./A are described. Three applications of each formulation were applied by mistblower to replicated 1-acre plots. No significant differences were observed between 8 and 16 billion I.U.'s. Efficacy was evaluated by foliage protection and population change.

(259) Zerillo, R. T., and T. M. Odell.
1973. **White pine weevil: A rearing procedure and artificial medium.** J. Econ. Entomol. 66(3) : 593–594, illus.

A rearing technique and a semiartificial medium for rearing *Pissodes strobi* (Peck) from egg through adult is described. Data on survival, fecundity, and adult size are discussed. The technique provides a uniform, aseptic procedure for rearing *P. strobi* in the laboratory.

THE FOREST SERVICE of the U. S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.